



*National Alliance for Medical Image Computing  
Neuroimage Analysis Center*

# **Data Loading & and Visualization**

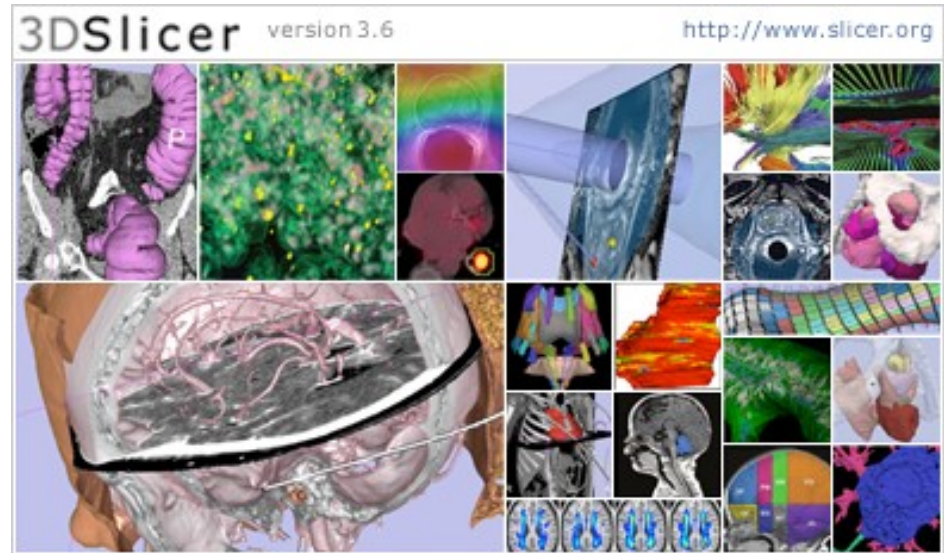
Sonia Pujol, Ph.D.

Surgical Planning Laboratory  
Harvard Medical School



*Leonardo da Vinci (1452-1519), Virgin and Child  
Alte Pinakothek, München*

- An **end-user application** for image analysis
- An **open-source environment** for software development
- A software platform that is both **easy to use** for clinical researchers and **easy to extend** for programmers



- Slicer3 is a **multi-platform** software that is developed and maintained on:
  - Windows XP
  - Linux x86\_64
  - Linux x86
  - Mac OSX – Darwin x86-Intel
  - Mac OSX – Darwin Power PC



# Download Slicer 3.6

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- Download and install the Slicer3.6 software from the Slicer web site

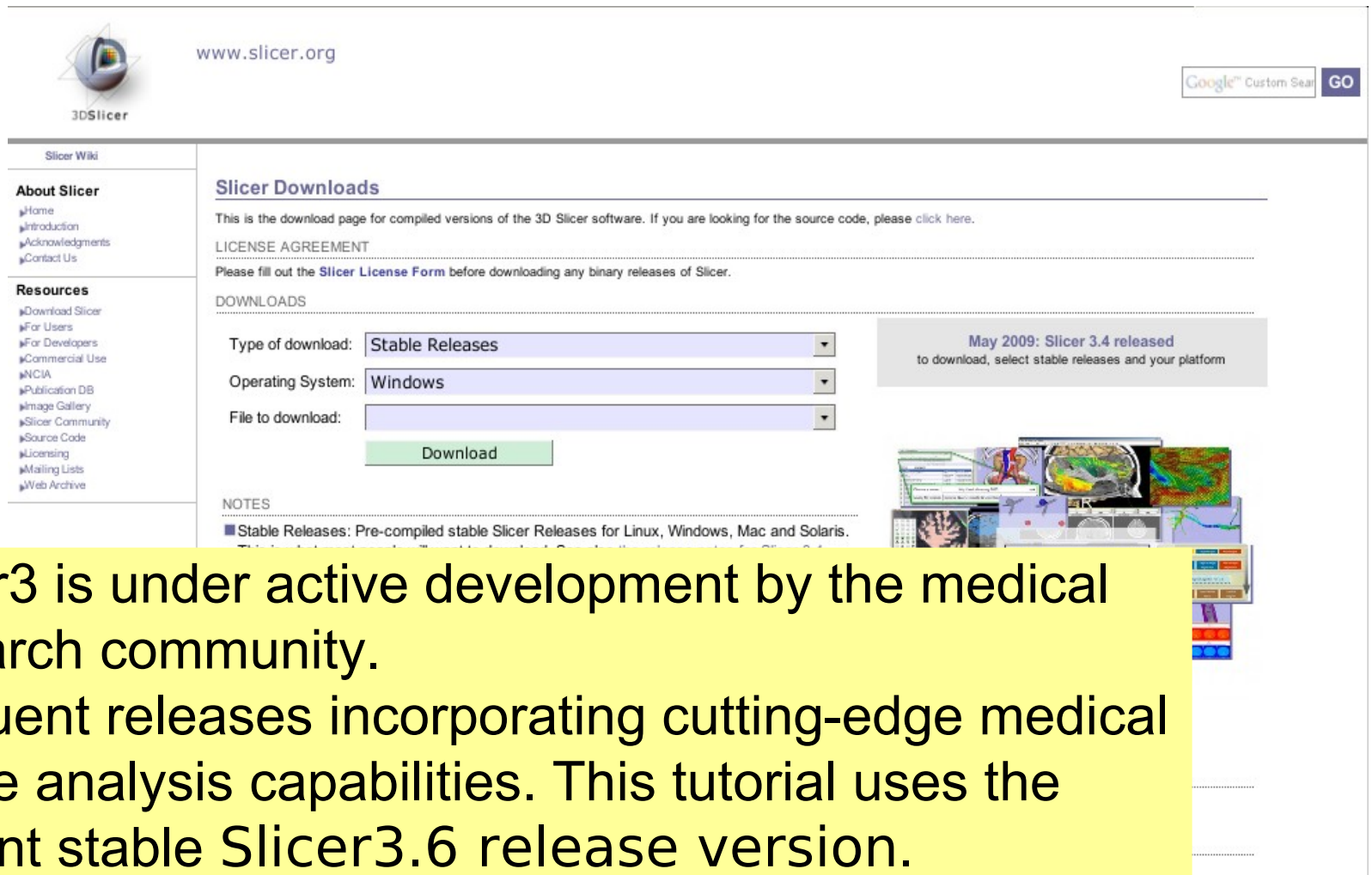
<http://www.slicer.org/pages/Special:SlicerDownloads>

## **Disclaimer**

It is the responsibility of the user of 3DSlicer to comply with both the terms of the license and with the applicable laws, regulations and rules.



# Download Slicer3.6



The screenshot shows the 3DSlicer website's download page. At the top, there is a 3DSlicer logo and the URL 'www.slicer.org'. A Google Custom Search bar is located in the top right corner. The left sidebar contains a 'Slicer Wiki' section with links for 'About Slicer' (Home, Introduction, Acknowledgments, Contact Us) and 'Resources' (Download Slicer, For Users, For Developers, Commercial Use, NCIA, Publication DB, Image Gallery, Slicer Community, Source Code, Licensing, Mailing Lists, Web Archive). The main content area is titled 'Slicer Downloads' and includes a note about source code, a 'LICENSE AGREEMENT' section, and a 'DOWNLOADS' section with three dropdown menus for 'Type of download' (Stable Releases), 'Operating System' (Windows), and 'File to download'. A 'Download' button is present. A grey box on the right states 'May 2009: Slicer 3.4 released to download, select stable releases and your platform'. Below the download section, there is a 'NOTES' section with a bullet point for 'Stable Releases: Pre-compiled stable Slicer Releases for Linux, Windows, Mac and Solaris.' and a collage of medical images.

**Slicer Downloads**

This is the download page for compiled versions of the 3D Slicer software. If you are looking for the source code, please [click here](#).

**LICENSE AGREEMENT**

Please fill out the [Slicer License Form](#) before downloading any binary releases of Slicer.

**DOWNLOADS**

Type of download: **Stable Releases**

Operating System: **Windows**

File to download:

**Download**

**NOTES**

- **Stable Releases:** Pre-compiled stable Slicer Releases for Linux, Windows, Mac and Solaris.

**May 2009: Slicer 3.4 released**  
to download, select stable releases and your platform

Slicer3 is under active development by the medical research community. Frequent releases incorporating cutting-edge medical image analysis capabilities. This tutorial uses the current stable Slicer3.6 release version.

# Download Slicer3.6



www.slicer.org

Google Custom Search

Select the type of download  
'Stable Releases'

Download Slicer software. If you are looking for the source code, please [click here](#).

Please fill out the [Slicer License Form](#) before downloading any binary releases of Slicer.

## DOWNLOADS

|   |                 |
|---|-----------------|
| Type of download:                       | Stable Releases |
| Operating System:                       | Windows         |
| File to download:                       |                 |
| <input type="button" value="Download"/> |                 |

**May 2009: Slicer 3.4 released**  
to download, select stable releases and your platform

## NOTES

- **Stable Releases:** Pre-compiled stable Slicer Releases for Linux, Windows, Mac and Solaris. This is what most people will want to download.
- **Snapshots:** Custom built Slicer binaries, in various states of completion, i.e. some features might not be stable.
- **Nightly builds:** This contains a week's worth of nightly builds. Nightly builds are experimental and sometimes unstable.
- **x86** means Intel or AMD processors, **ppc** means PowerPC processors
- **Mac:** Darwin is the OpenSource software environment for Apple's Mac OS X
- **Hardware/OS requirement:** Either Windows XP or more recent, Linux (x86 or x86\_64), Mac OS X (ppc or Intel), min 2 GB of RAM and a dedicated graphic accelerator with at least 128 MB of on-board graphic memory. Shared memory graphics will result in slow render speeds.
- **X11 for Mac:** On Mac OS X you will need to install X11 from the CD. As an alternative, we had good experience with [xquartz](#).



# Download Slicer3.6



www.slicer.org

Google™ Custom Search **GO**

Select the Operating System appropriate for your computer.

[Knowledge Base](#)  
[Contact Us](#)

## Resources

[Download Slicer](#)  
[For Users](#)  
[For Developers](#)  
[Commercial Use](#)  
[NCLIA](#)  
[Publication DB](#)  
[Image Gallery](#)  
[Slicer Community](#)  
[Source Code](#)  
[Licensing](#)  
[Mailing Lists](#)  
[Web Archive](#)

## LICENSE AGREEMENT

Please fill out the [Slicer License Form](#) before downloading any binary releases of Slicer.

## DOWNLOADS

Type of download:

Operating System:

File to download:

[Download](#)

May 2009: Slicer 3.4 released  
to download, select stable releases and your platform



## NOTES

- **Stable Releases:** Pre-compiled stable Slicer Releases for Linux, Windows, Mac and Solaris. This is what most people will want to download. See also the [release notes](#) for Slicer 3.4
- **Snapshots:** Custom built Slicer binaries, in various states of completion, i.e. some features might not be stable.
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- **X11 for Mac:** On Mac OS X you will need to install X11 from the CD. As an alternative, we had good experience with [xquartz](#).

## DOCUMENTATION AND TRAINING

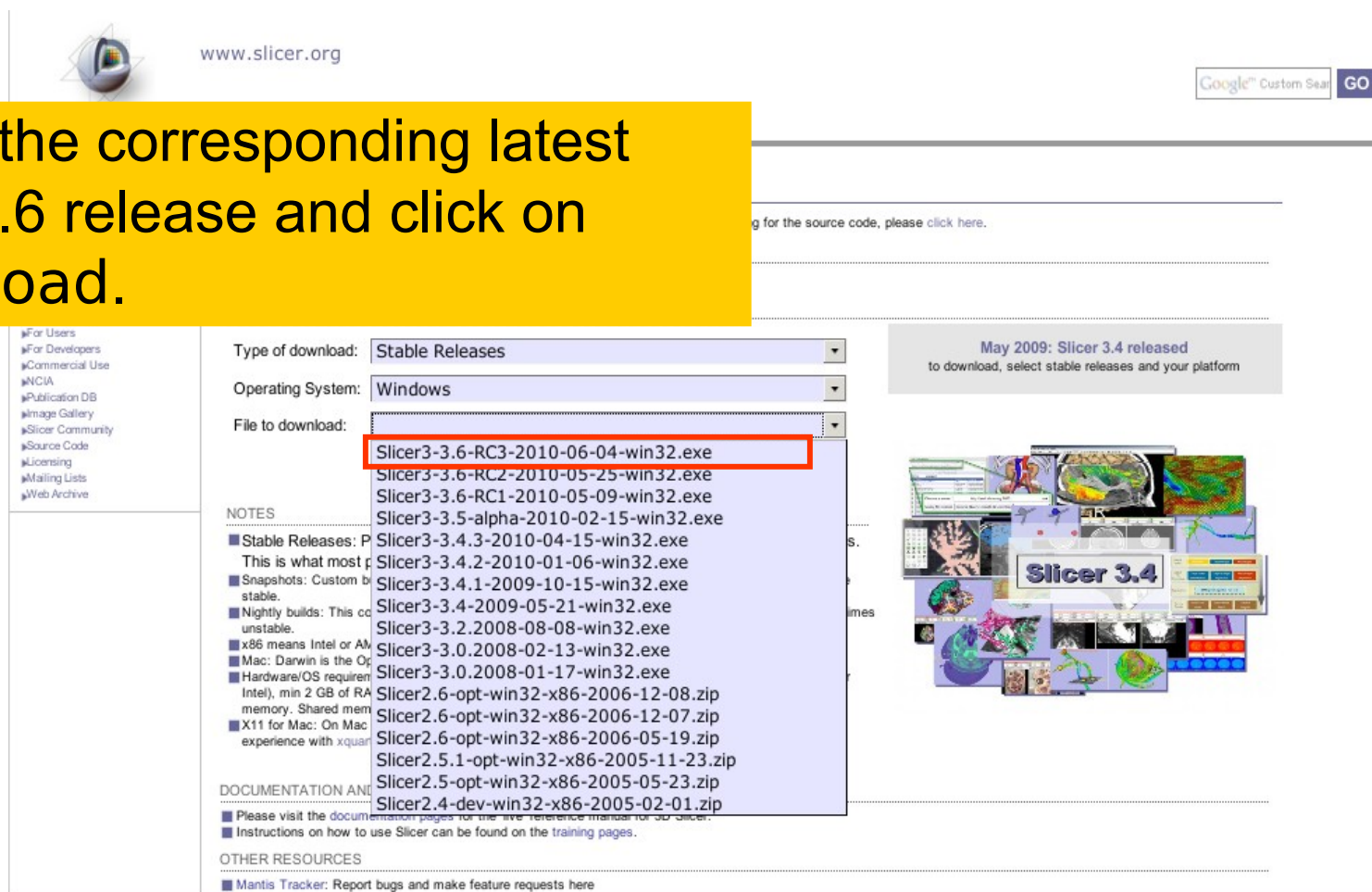
- Please visit the [documentation pages](#) for the 'live' reference manual for 3D Slicer.
- Instructions on how to use Slicer can be found on the [training pages](#).

## OTHER RESOURCES

- [Mantis Tracker:](#) Report bugs and make feature requests here

# Download Slicer3.6

Select the corresponding latest Slicer3.6 release and click on Download.



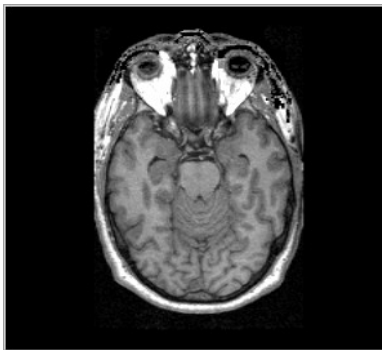
The screenshot shows the 3DSlicer website with the following elements:

- Header:** 3DSlicer logo and website URL [www.slicer.org](http://www.slicer.org). A Google Custom Search bar is also present.
- Navigation Menu:** Links for Users, Developers, Commercial Use, NCIA, Publication DB, Image Gallery, Slicer Community, Source Code, Licensing, Mailing Lists, and Web Archive.
- Download Section:**
  - Type of download:** Stable Releases
  - Operating System:** Windows
  - File to download:** A list of files is shown, with **Slicer3-3.6-RC3-2010-06-04-win32.exe** highlighted in a red box.
- Notes:**
  - Stable Releases:** This is what most people use.
  - Snapshots:** Custom builds.
  - Nightly builds:** This code is unstable.
  - x86 means Intel or AMD.**
  - Mac:** Darwin is the operating system.
  - Hardware/OS requirements:** Intel, min 2 GB of RAM, 10 GB of free disk space.
  - X11 for Mac:** On Mac OS X, you need to install X11 and have it running.
- Documentation and Training:**
  - Please visit the documentation pages for the latest reference manual for 3D Slicer.
  - Instructions on how to use Slicer can be found on the training pages.
- Other Resources:**
  - Mantis Tracker: Report bugs and make feature requests here
- Announcement:** May 2009: Slicer 3.4 released to download, select stable releases and your platform.
- Image Gallery:** A collage of various medical image processing results, including brain scans, heart models, and 3D reconstructions.

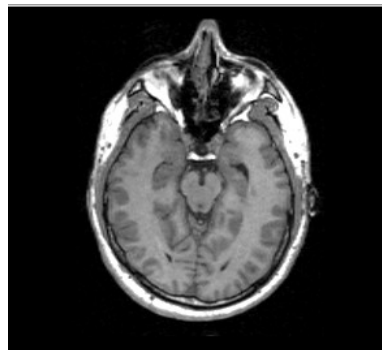
# Download the training dataset

---

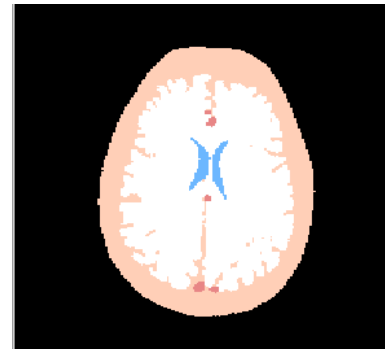
- This course is built upon three datasets of a single healthy subject brain:



MR DICOM  
GRASS



MR Nrrd  
SPGR



Pre-computed  
Label Map

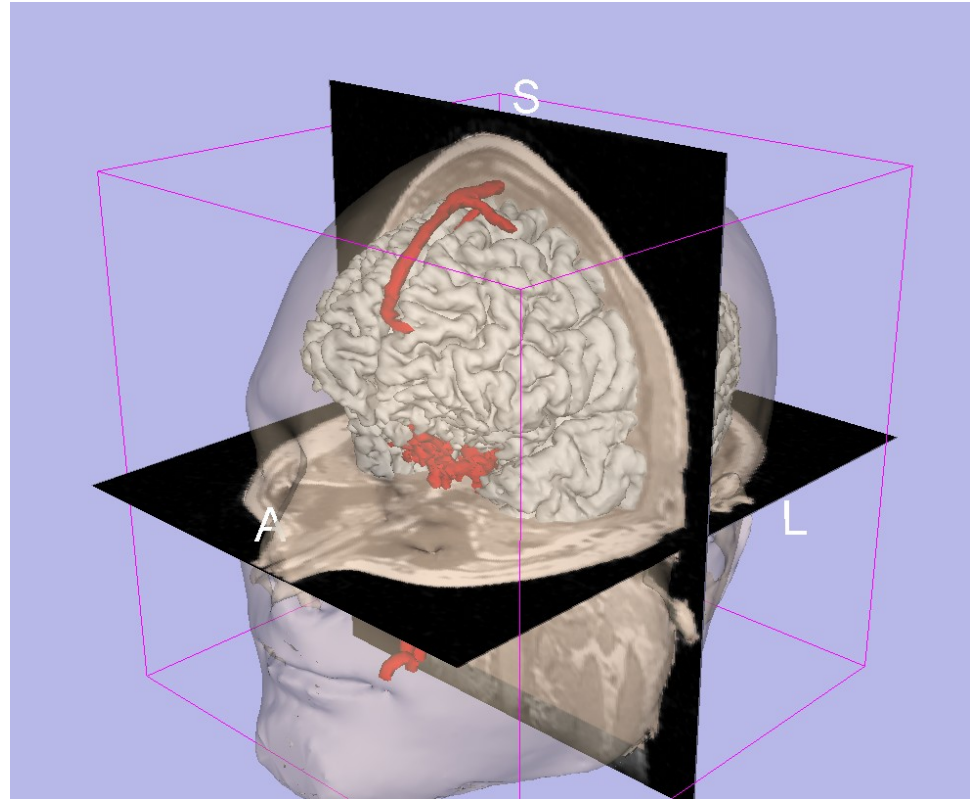
- Download and unzip the training dataset

Slicer3VisualizationDataset.zip

<http://www.slicer.org/slicerWiki/index.php/Slicer3.6:Training>

# Learning objective

Following this tutorial, you'll be able to **load and visualize volumes** within Slicer3, and to **interact in 3D** with structural images and models.



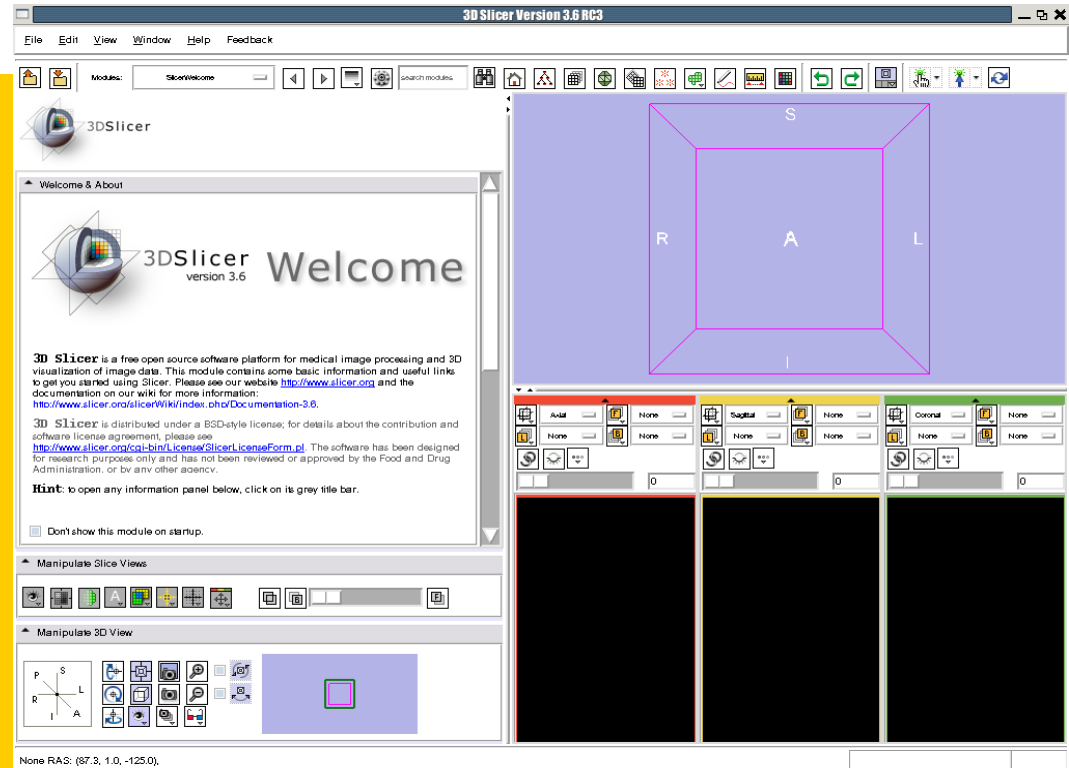




# Start Slicer3

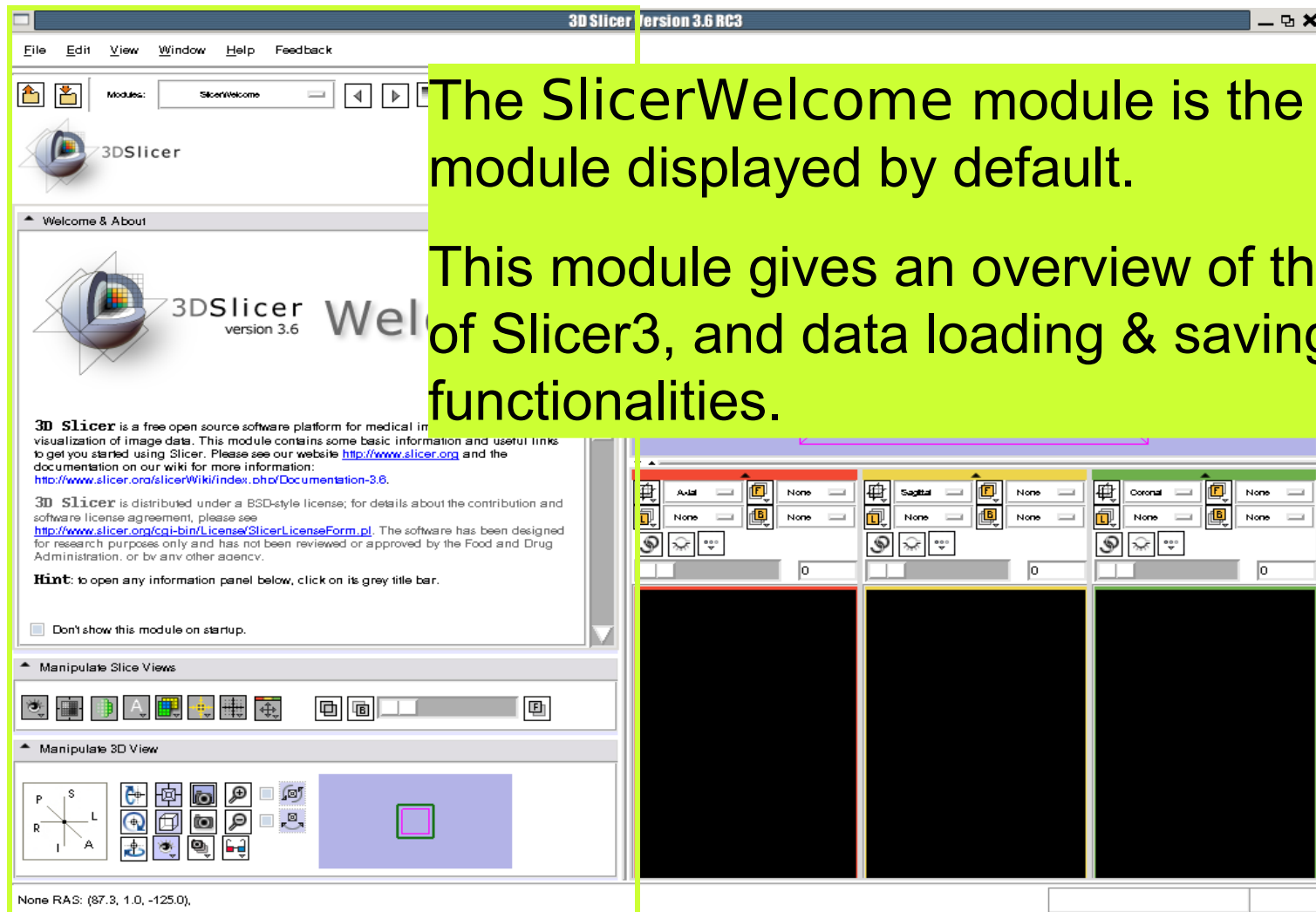
Linux/Mac users  
Launch the Slicer3  
executable located in  
the Slicer3.6 directory

Windows users  
Select  
Start → All Programs  
→ Slicer3-3.6-RC3-2010-05-21 → Slicer3





# Slicer Welcome

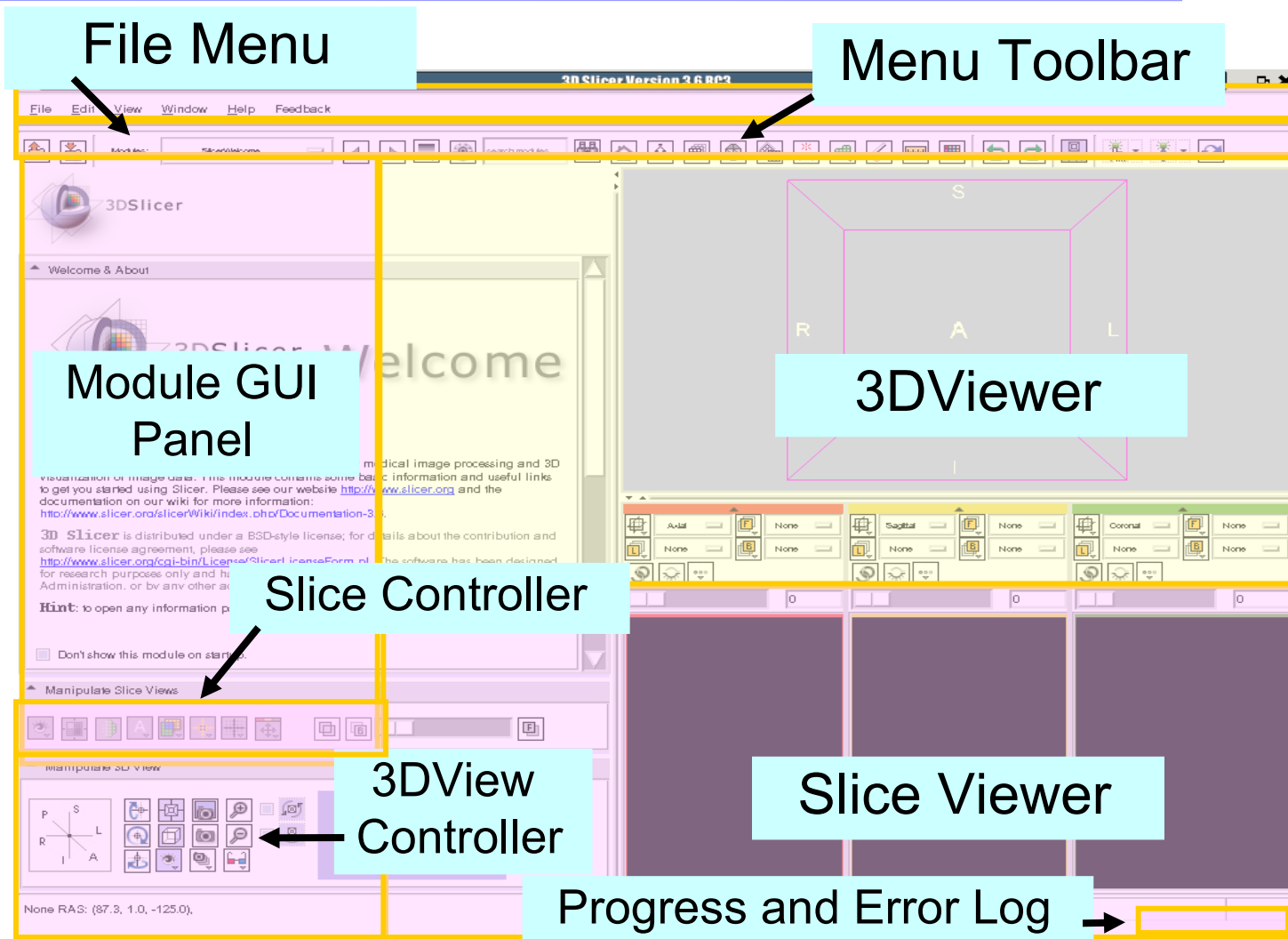




# Slicer3 GUI

The Graphical User Interface (GUI) of Slicer3.6 integrates 8 main components:

- the File Menu
- the Menu Toolbar
- the Module GUI Panel
- the 3D Viewer
- the Slice Viewer
- the Slice Controller
- the 3D View Controller

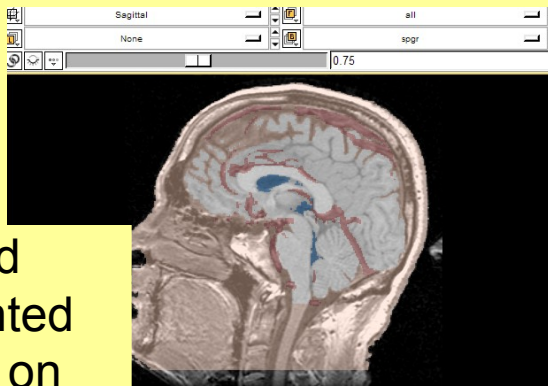


# Overview

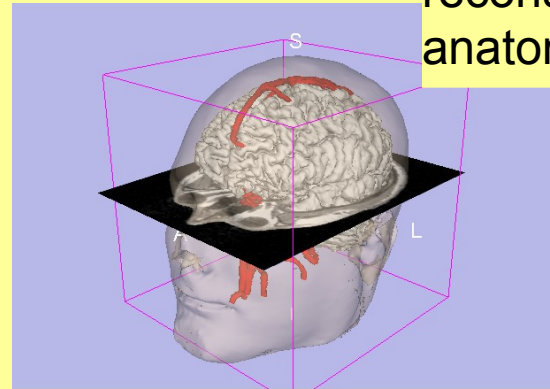
**Part 1.** Loading and visualizing multiple volumes simultaneously



**Part 2.** Loading and visualizing segmented structures overlaid on grayscale images



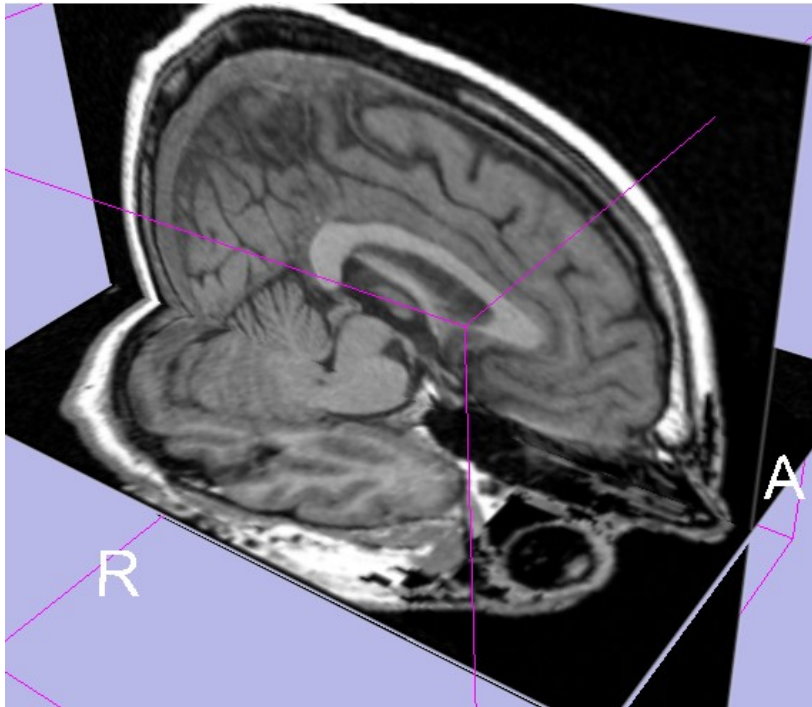
**Part 3.** Visualizing 3D reconstructions of anatomical surfaces



**Part 4.** The lightbox viewer

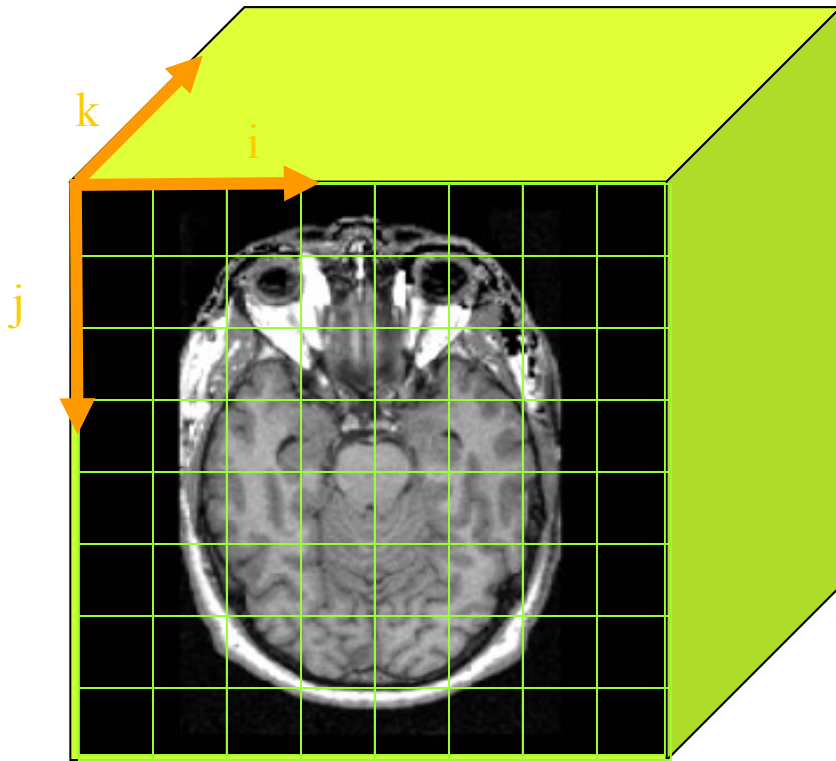


**Part 5.** Saving data



## Part 1: Loading and visualizing multiple volumes simultaneously

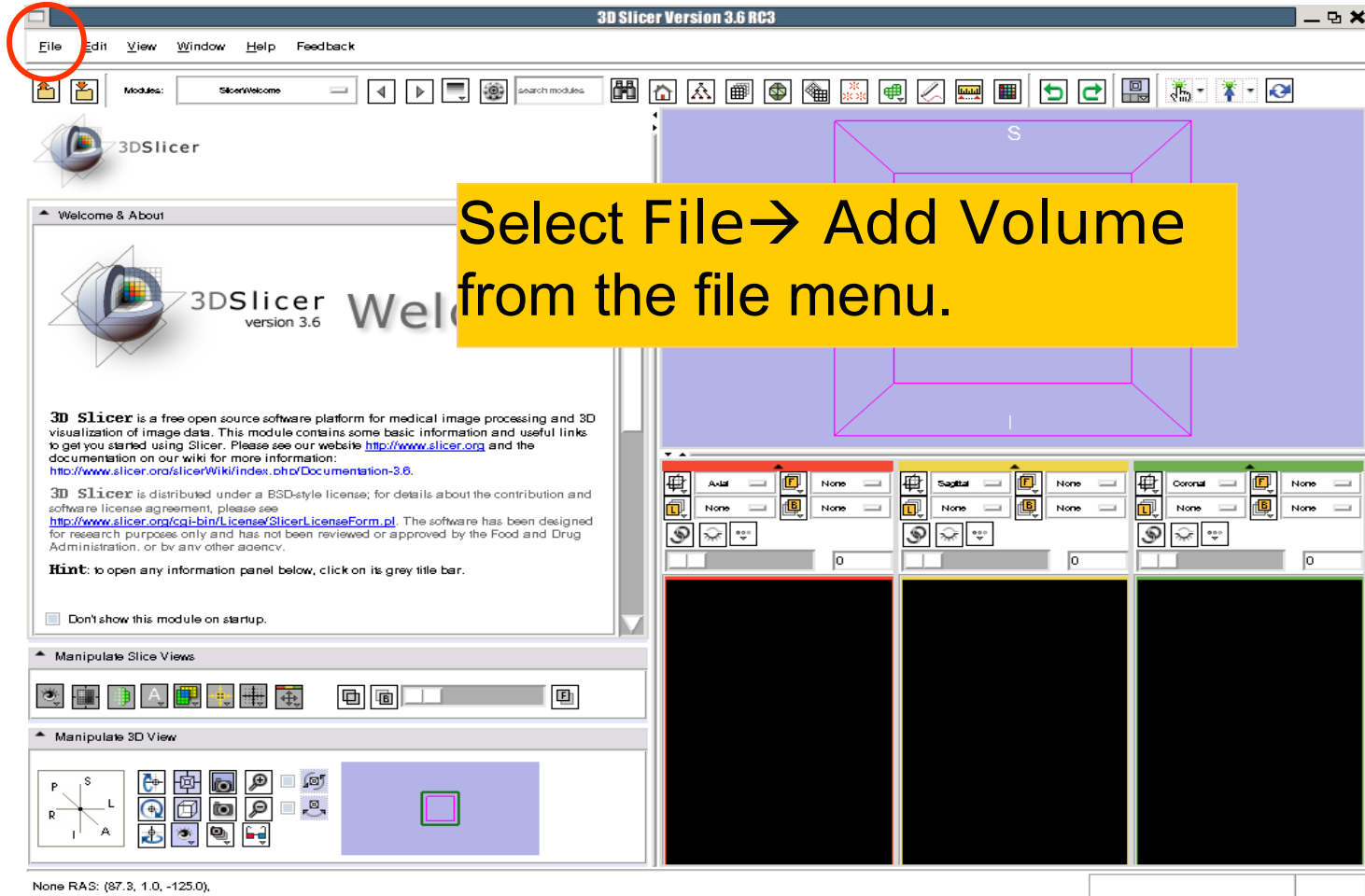
# Data Representation



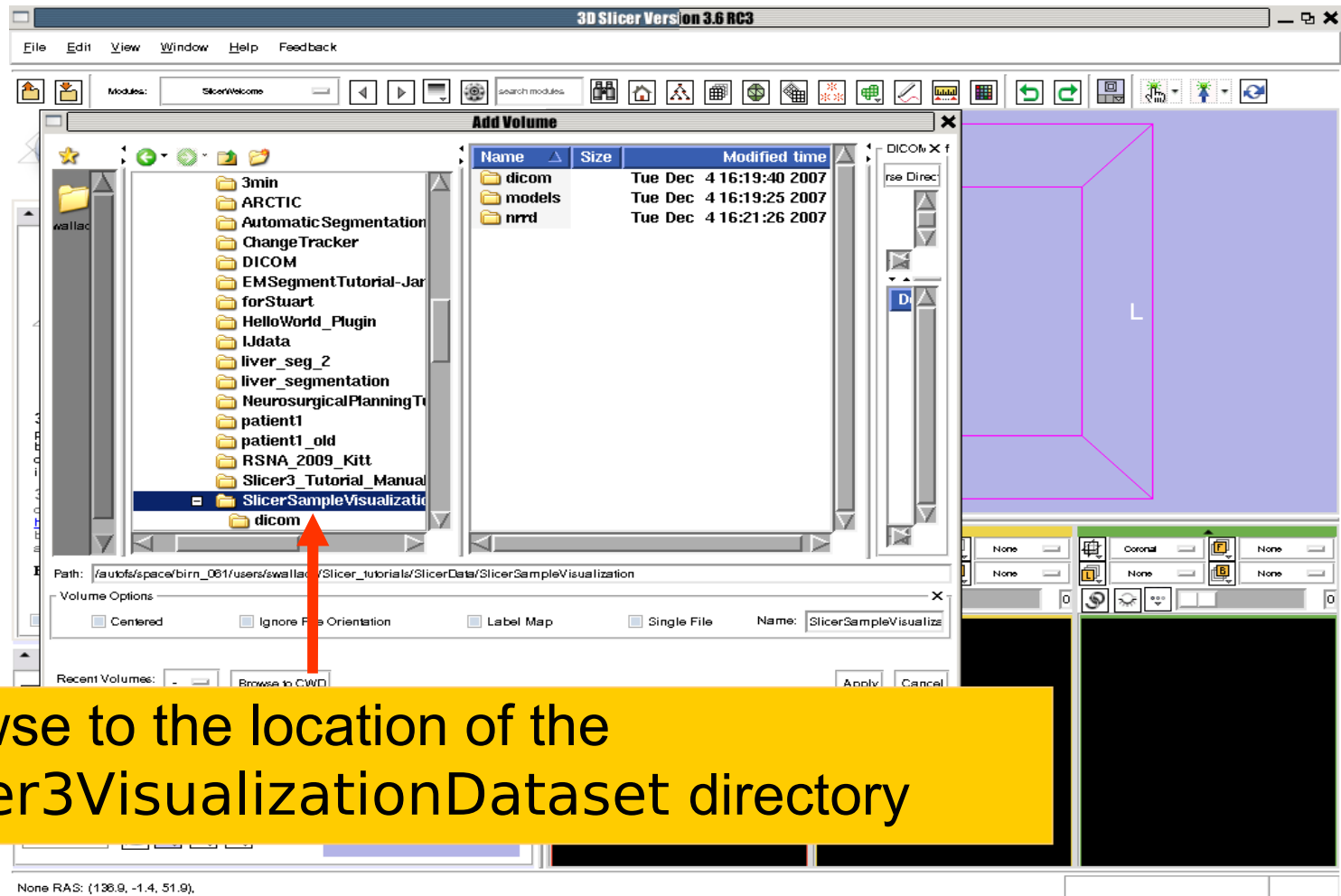
- The result of a volumetric acquisition is a **3D volume of data** related to the patient.
- The 3D raster dataset is sampled on a discrete grid with elements called **voxels** which contain the **signal intensity**.



# Loading Volumes

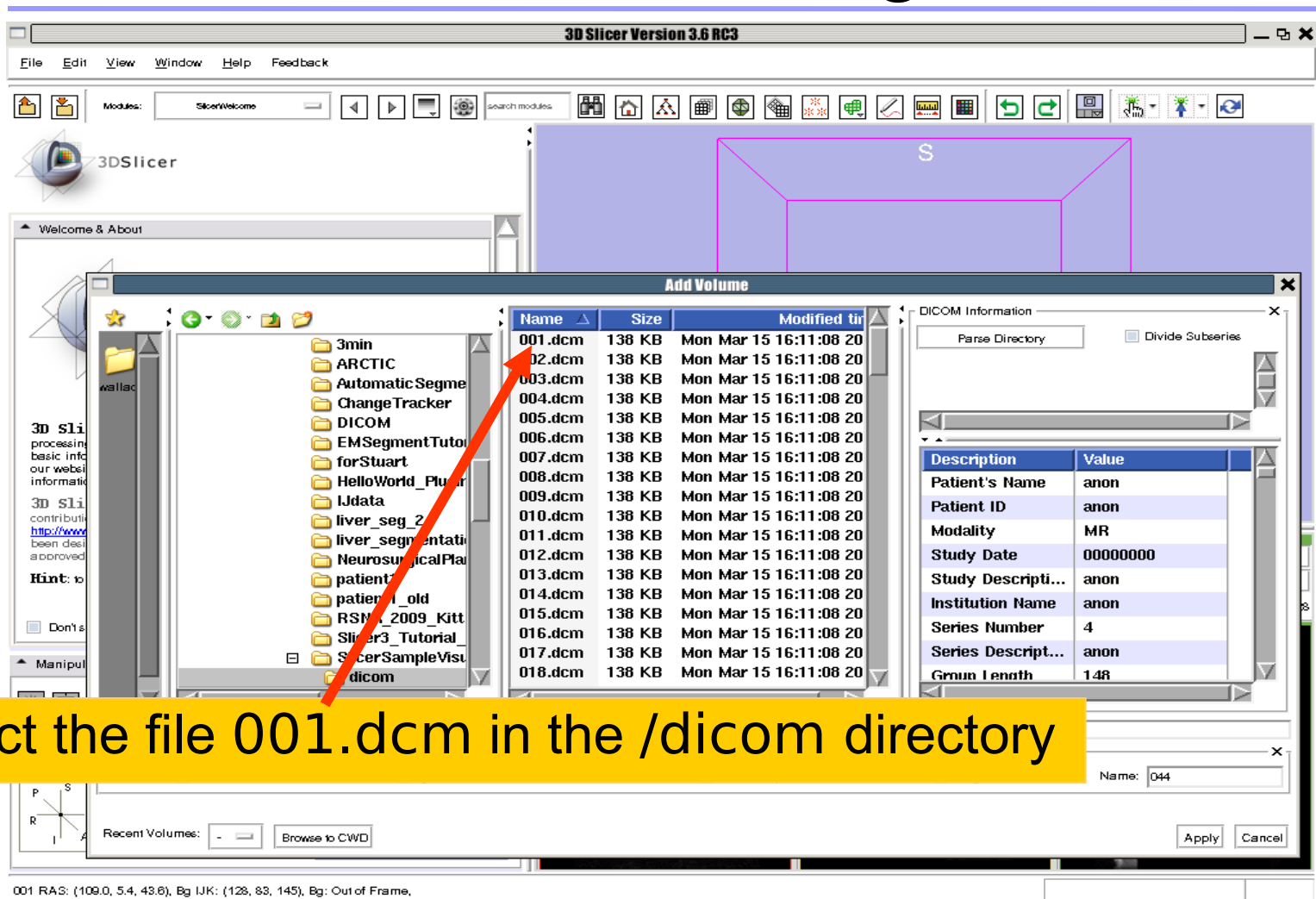


# Loading Volumes



Browse to the location of the Slicer3VisualizationDataset directory

# Loading Volumes



3D Slicer Version 3.6 RC3

File Edit View Window Help Feedback

Modules: SlicerWelcome

Welcome & About

3D Slicer

Add Volume

| Name    | Size   | Modified time          |
|---------|--------|------------------------|
| 001.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 002.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 003.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 004.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 005.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 006.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 007.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 008.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 009.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 010.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 011.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 012.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 013.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 014.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 015.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 016.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 017.dcm | 138 KB | Mon Mar 15 16:11:08 20 |
| 018.dcm | 138 KB | Mon Mar 15 16:11:08 20 |

DICOM Information

Parse Directory ☐ Divide Subseries

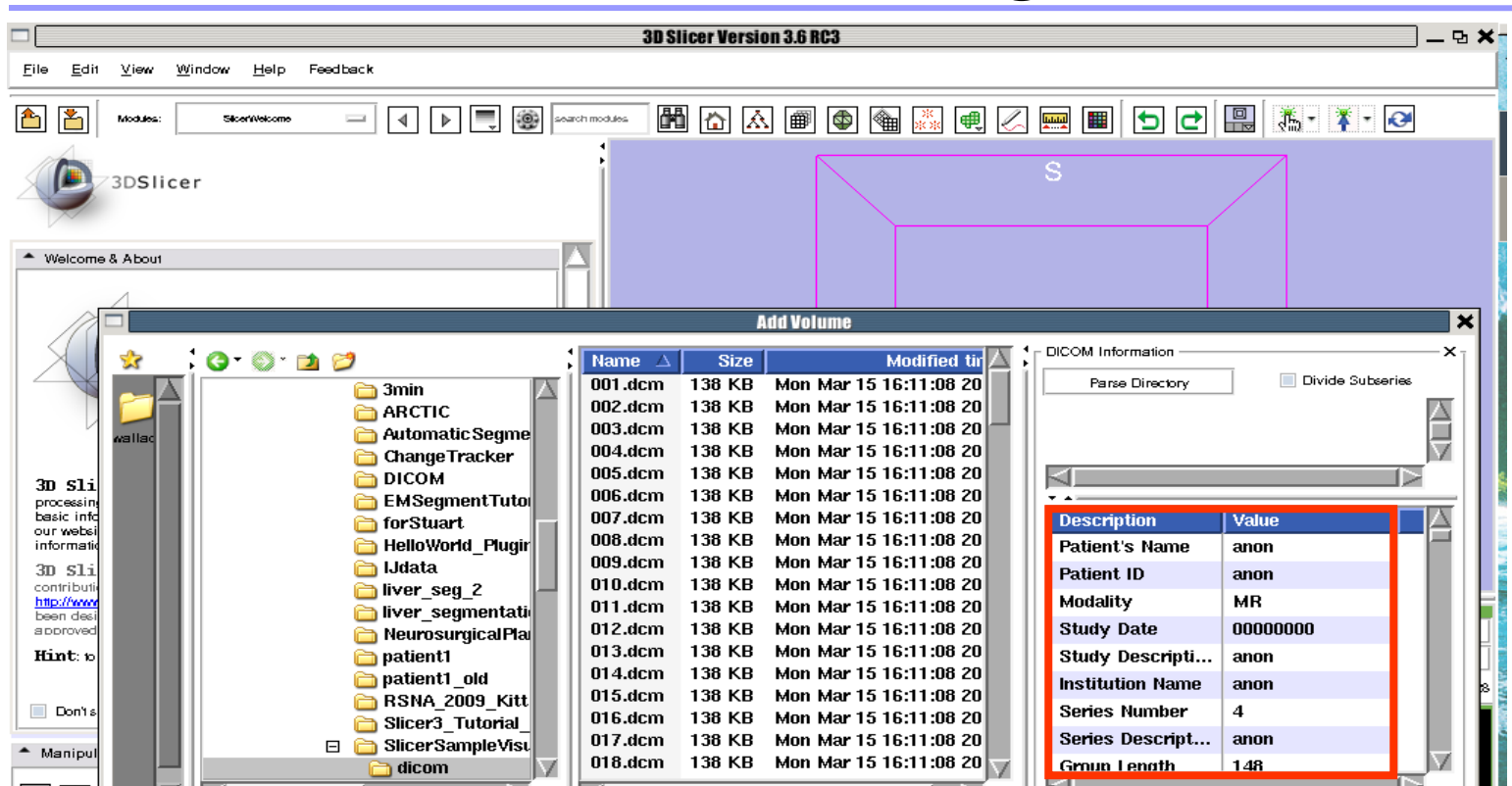
| Description        | Value    |
|--------------------|----------|
| Patient's Name     | anon     |
| Patient ID         | anon     |
| Modality           | MR       |
| Study Date         | 00000000 |
| Study Descripti... | anon     |
| Institution Name   | anon     |
| Series Number      | 4        |
| Series Descript... | anon     |
| Group Length       | 148      |

Recent Volumes: - Browse to CWD

001 RAS: (109.0, 5.4, 43.6), Bg LUK: (128, 83, 145), Bg: Out of Frame.

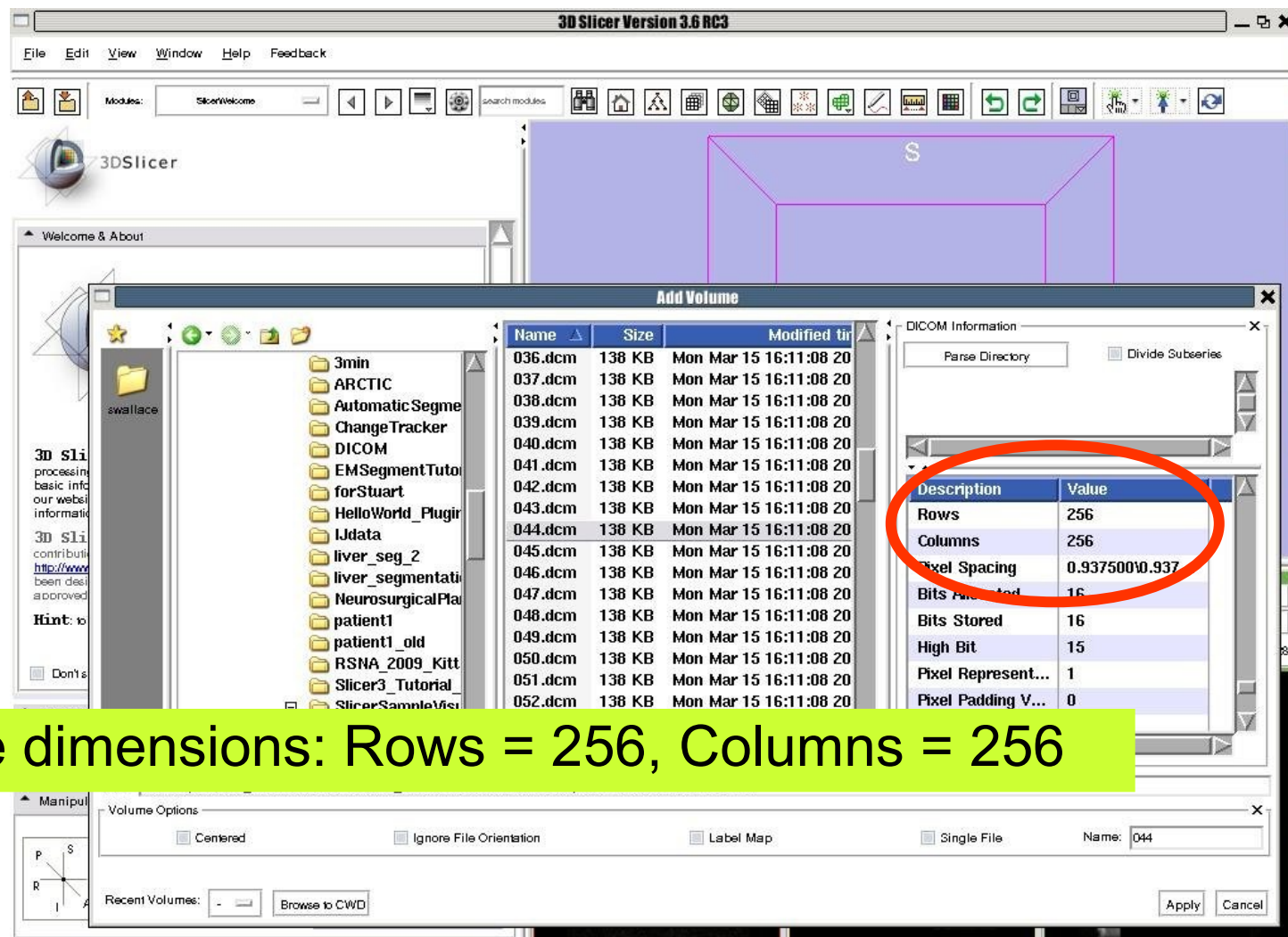
Select the file 001.dcm in the /dicom directory

# Loading Volumes

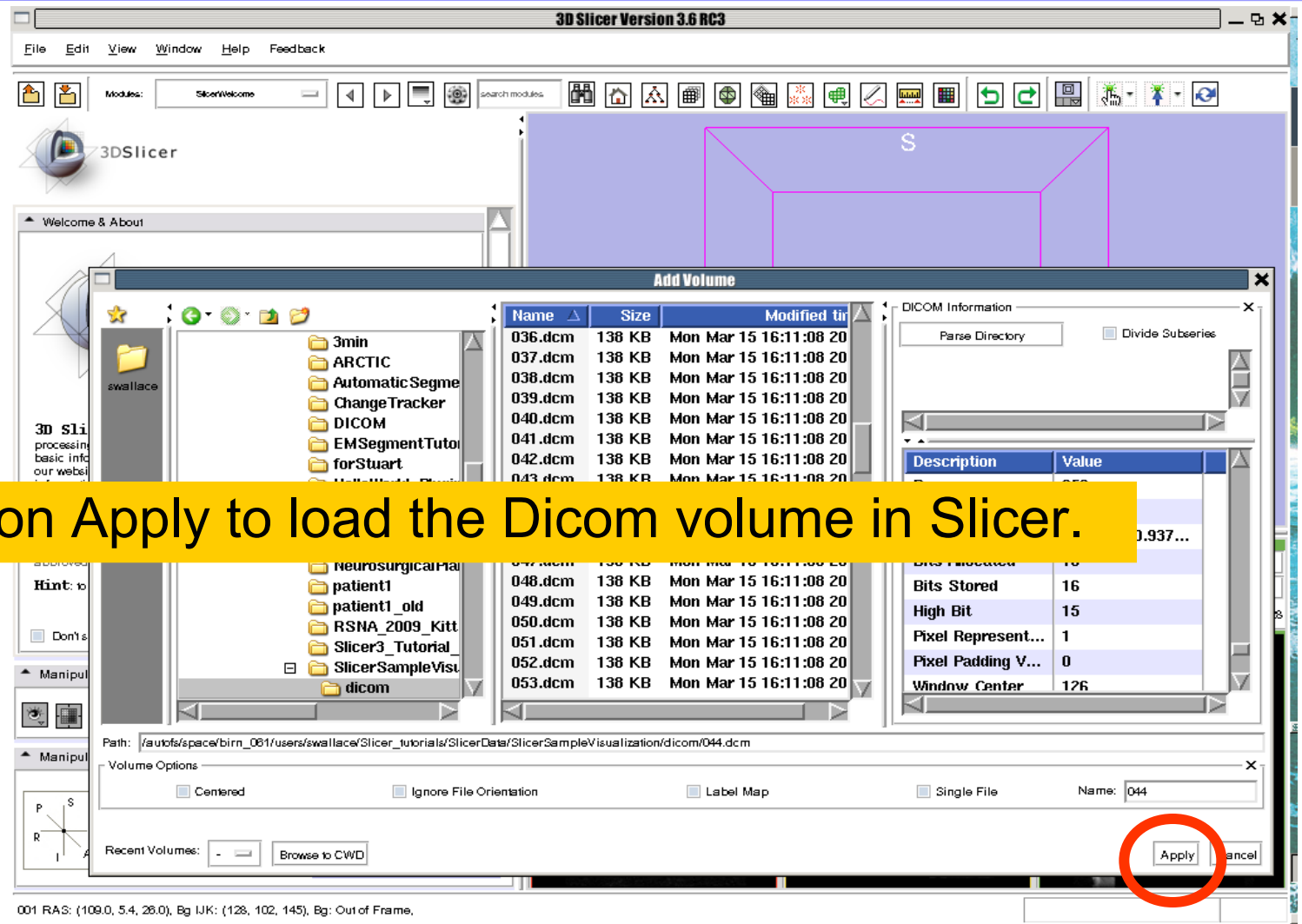


Slicer displays the Dicom header information of the images. Browse through the Dicom information panel to display the dimensions of the images.

# Loading Volumes



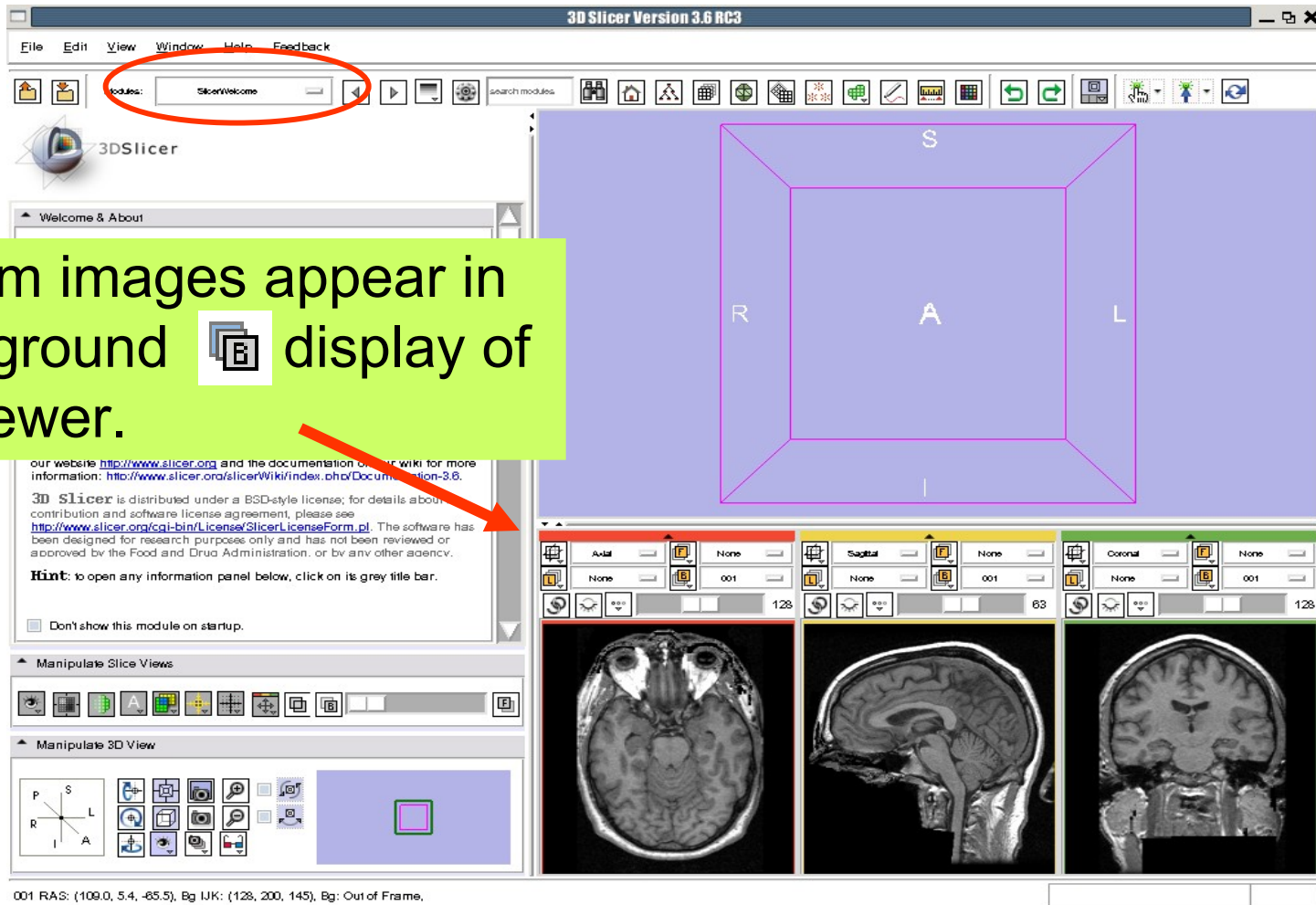
# Loading Volumes




Click on Apply to load the Dicom volume in Slicer.

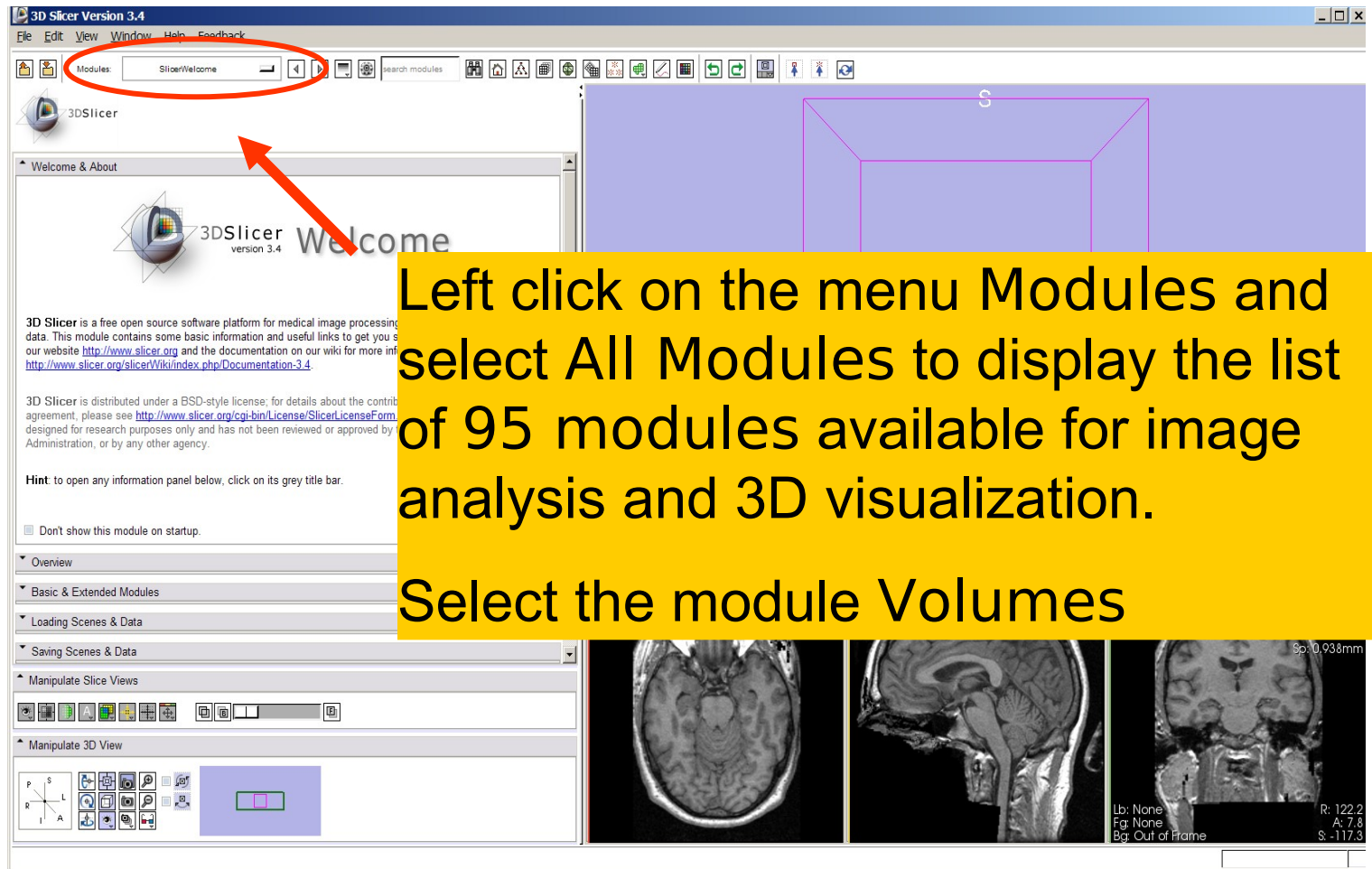


# Loading Volumes



The Dicom images appear in the Background  display of the 2DViewer.

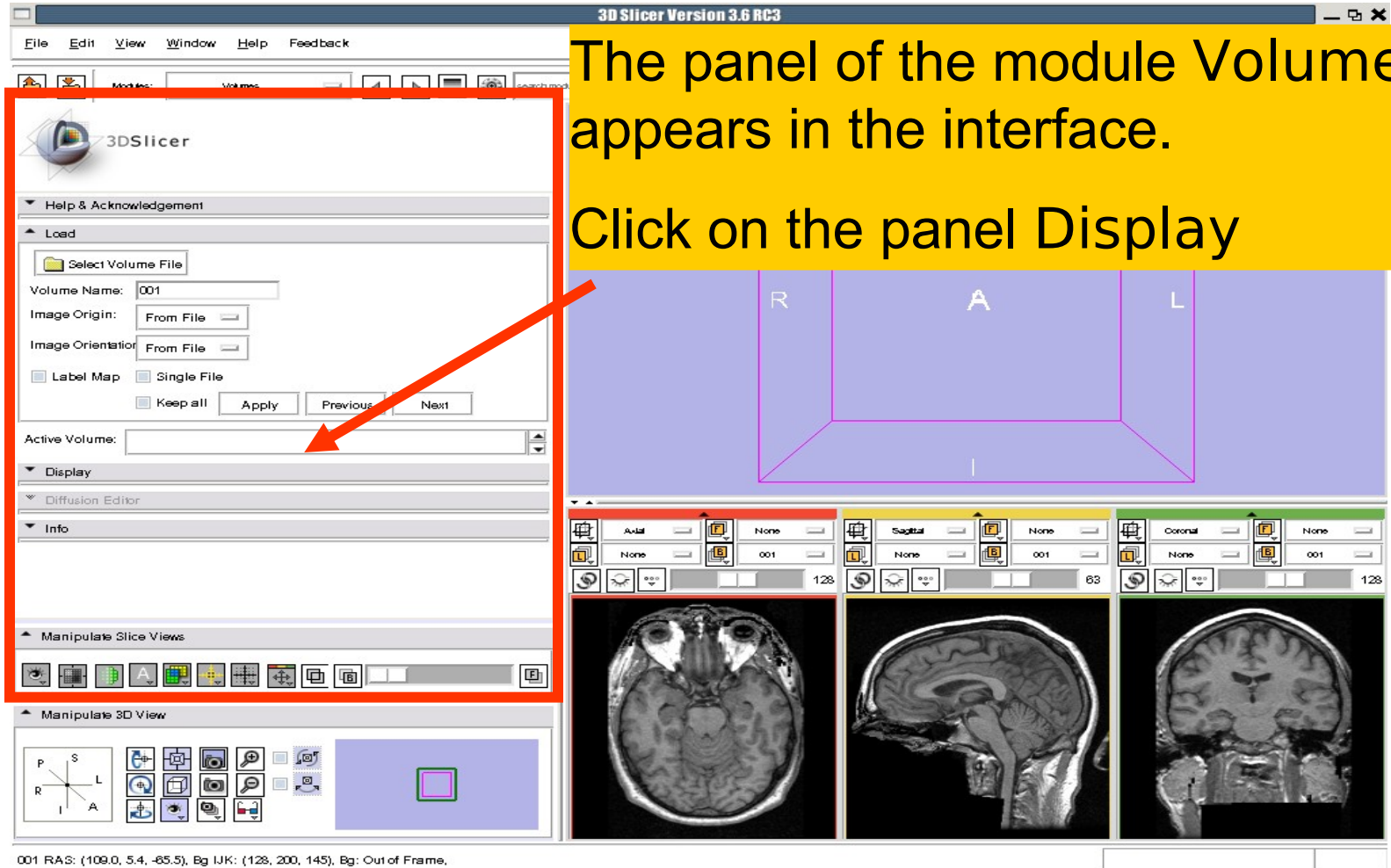
# Loading Volumes



# Loading Volumes

The panel of the module Volumes appears in the interface.

Click on the panel Display



001 RAS: (109.0, 5.4, -65.5), Bg IJK: (128, 200, 145), Bg: Out of Frame.

# Loading Volumes

3D Slicer Version 3.6 RC3

File Edit View Window Help Feedback

Modules: Volumes

Use the Window/Level slider to adjust the display of the MR images.

Lookup Table: Grey

☒ Interpolate

Window Level Editor Presets:

Volume Window Level Presets:

Window/Level: Manual 140 70

Threshold: Off 0 293

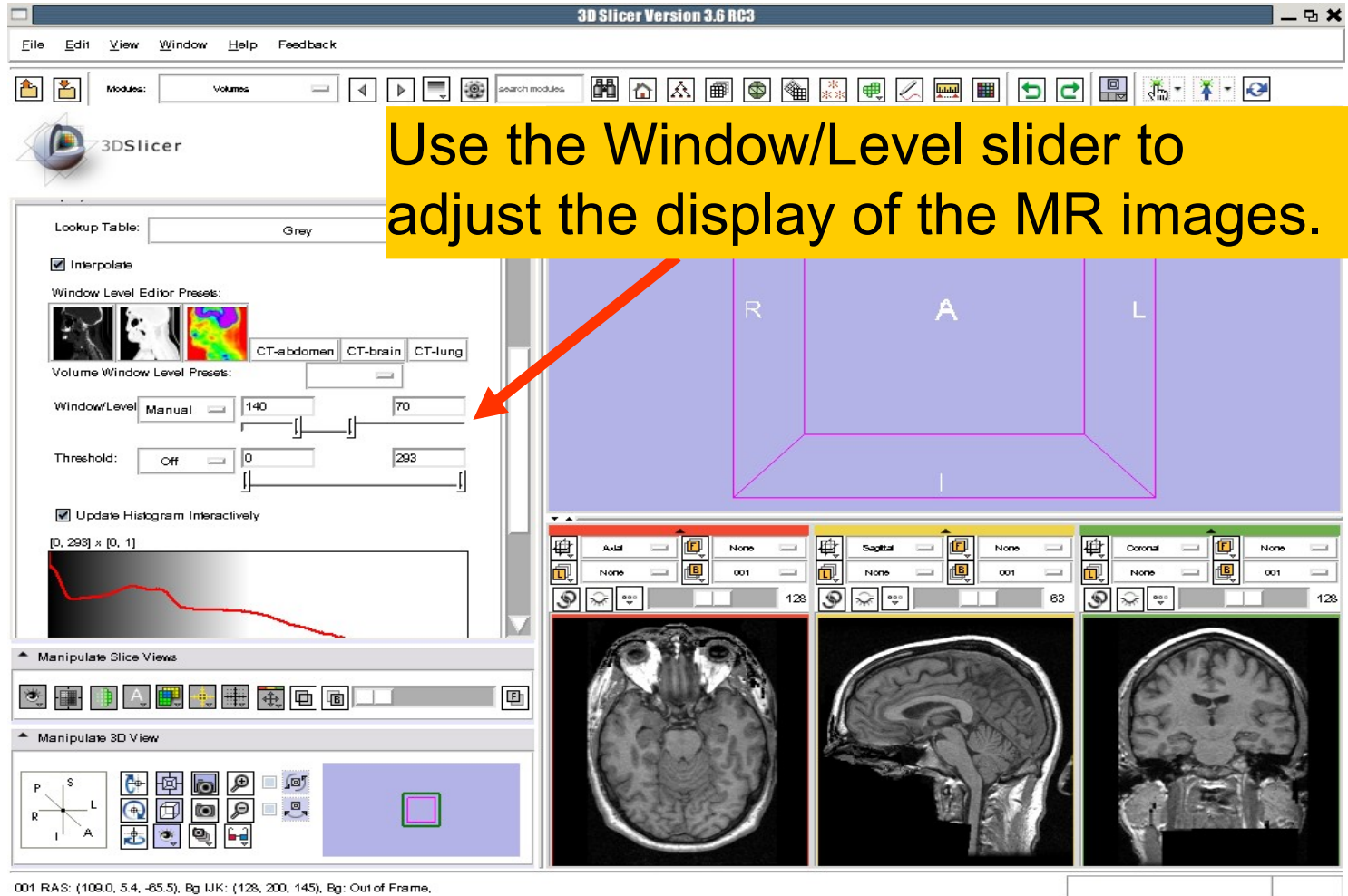
☒ Update Histogram Interactively

[0, 293] x [0, 1]

Manipulate Slice Views

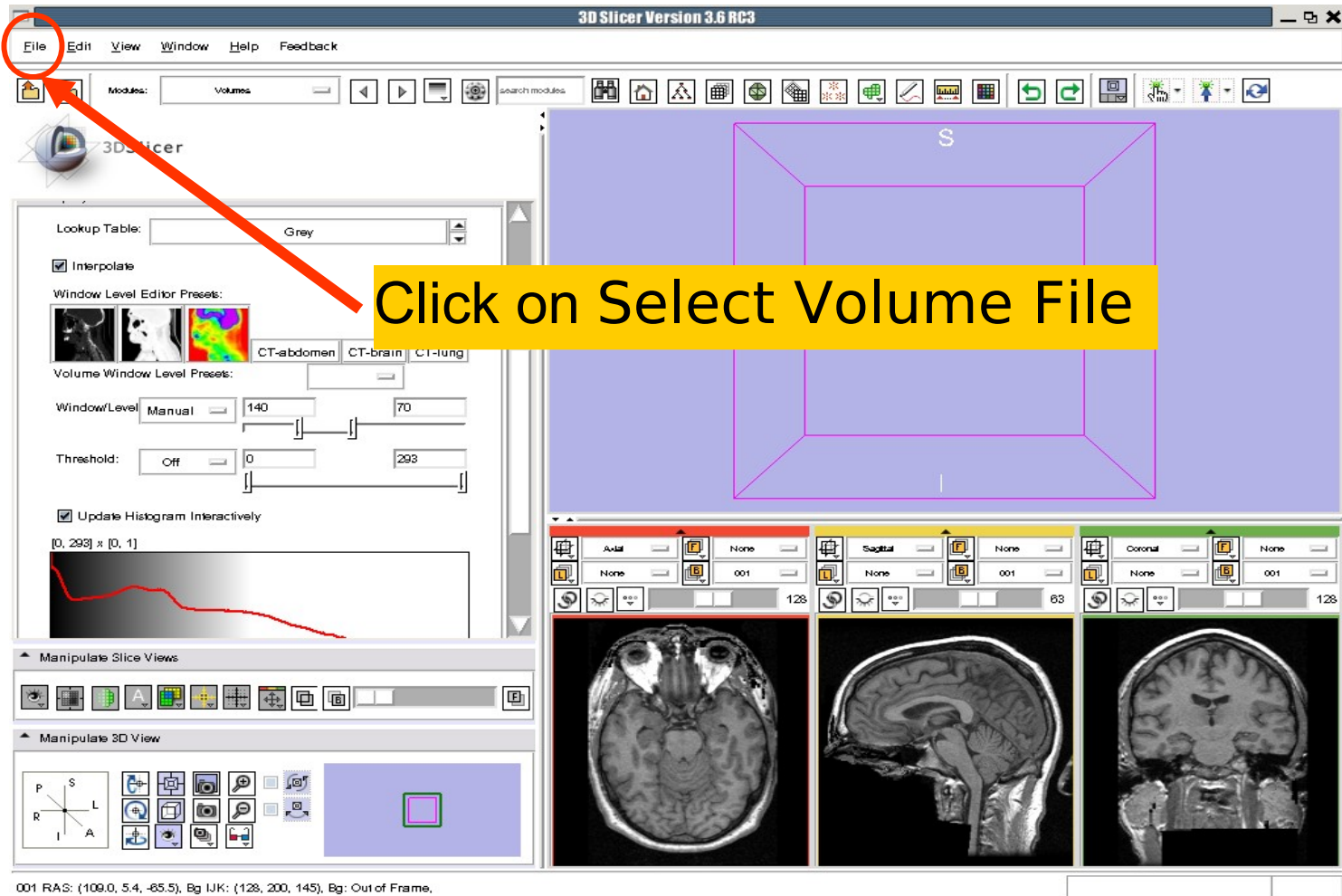
Manipulate 3D View

001 RAS: (109.0, 5.4, -85.5), Bg IJK: (128, 200, 145), Bg: Out of Frame.



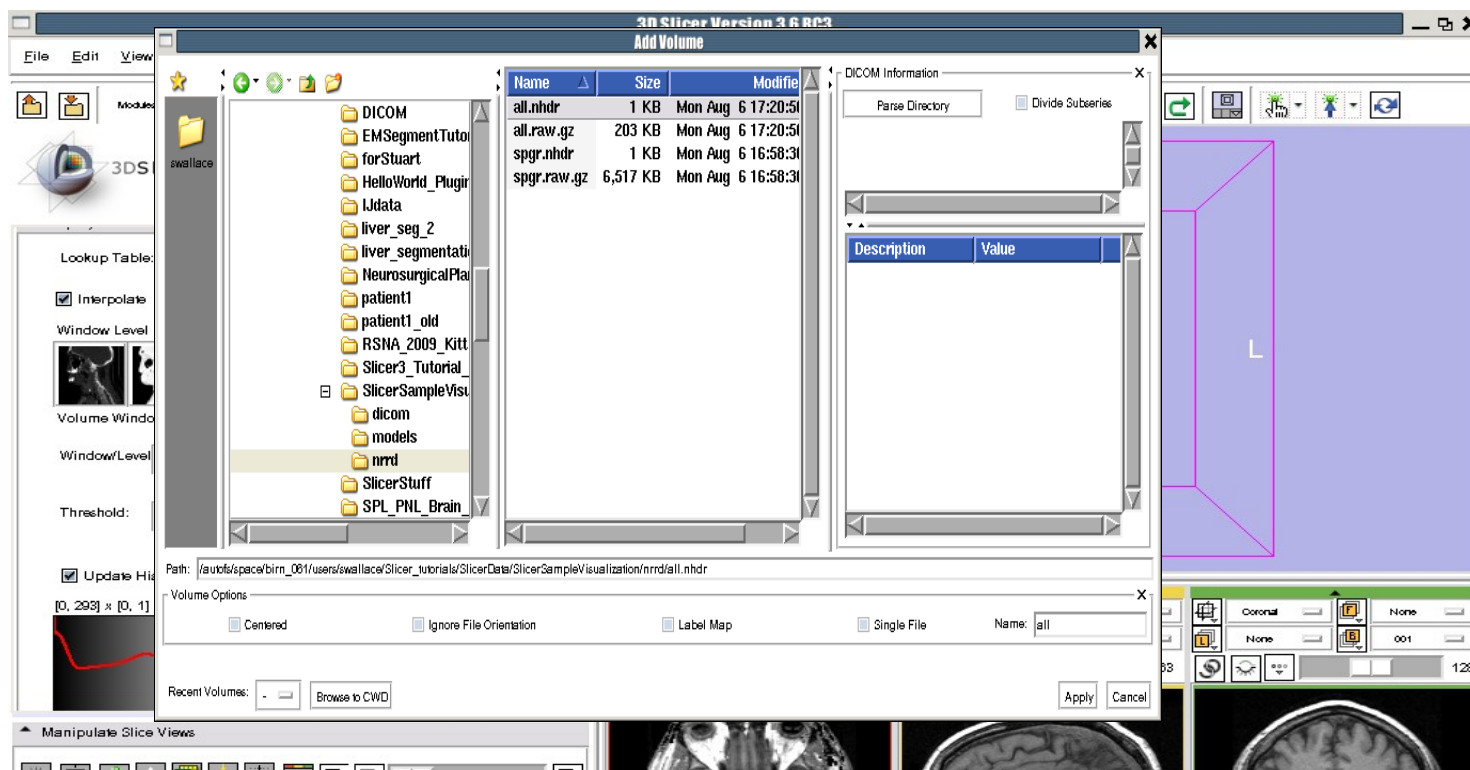
The screenshot displays the 3D Slicer software interface. At the top, the title bar reads '3D Slicer Version 3.6 RC3'. Below it is a menu bar with 'File', 'Edit', 'View', 'Window', 'Help', and 'Feedback'. A toolbar contains various icons for file operations, viewing, and editing. The 'Modules' panel on the left shows 'Volumes' as the active module. A large yellow text box with a red arrow pointing to the 'Window/Level' slider in the 'Volumes' module panel contains the text 'Use the Window/Level slider to adjust the display of the MR images.' The 'Volumes' module panel includes a 'Lookup Table' dropdown set to 'Grey', an 'Interpolate' checkbox checked, 'Window Level Editor Presets' (CT-abdomen, CT-brain, CT-lung), 'Volume Window Level Presets', and a 'Window/Level' slider set to 'Manual' with values '140' and '70'. Below this is a 'Threshold' section with 'Off' selected and values '0' and '293'. A histogram is visible at the bottom of the panel. The main 3D view area shows a large purple rectangular volume. Below the 3D view are three slice view panels: 'Axial', 'Sagittal', and 'Coronal'. Each panel has a dropdown menu for the slice type and a 'None' button. The 'Axial' panel shows a brain slice, the 'Sagittal' panel shows a sagittal brain slice, and the 'Coronal' panel shows a coronal brain slice. At the bottom, a status bar displays coordinates: '001 RAS: (109.0, 5.4, -85.5), Bg IJK: (128, 200, 145), Bg: Out of Frame.'

# Loading Volumes





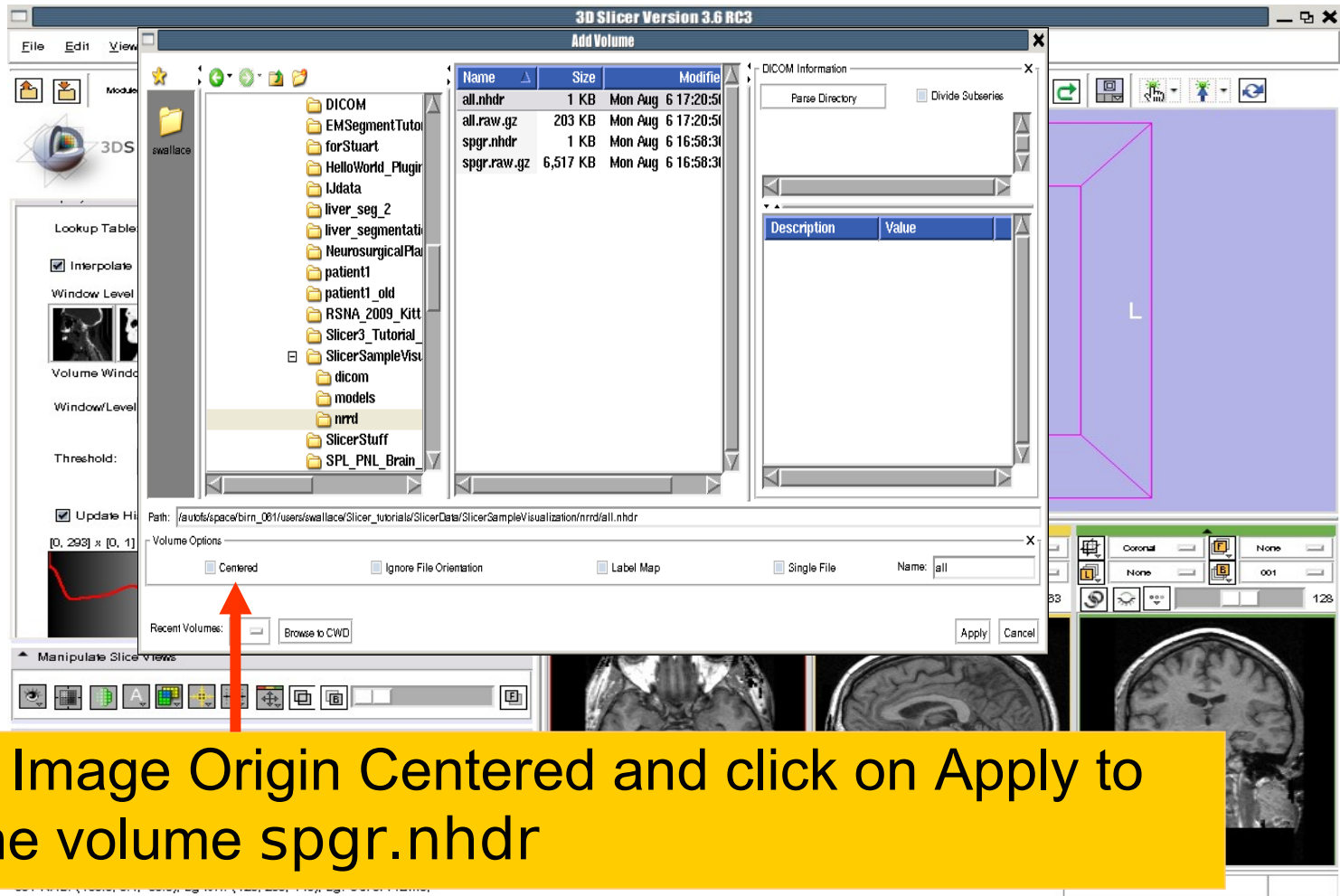
# Loading Volumes



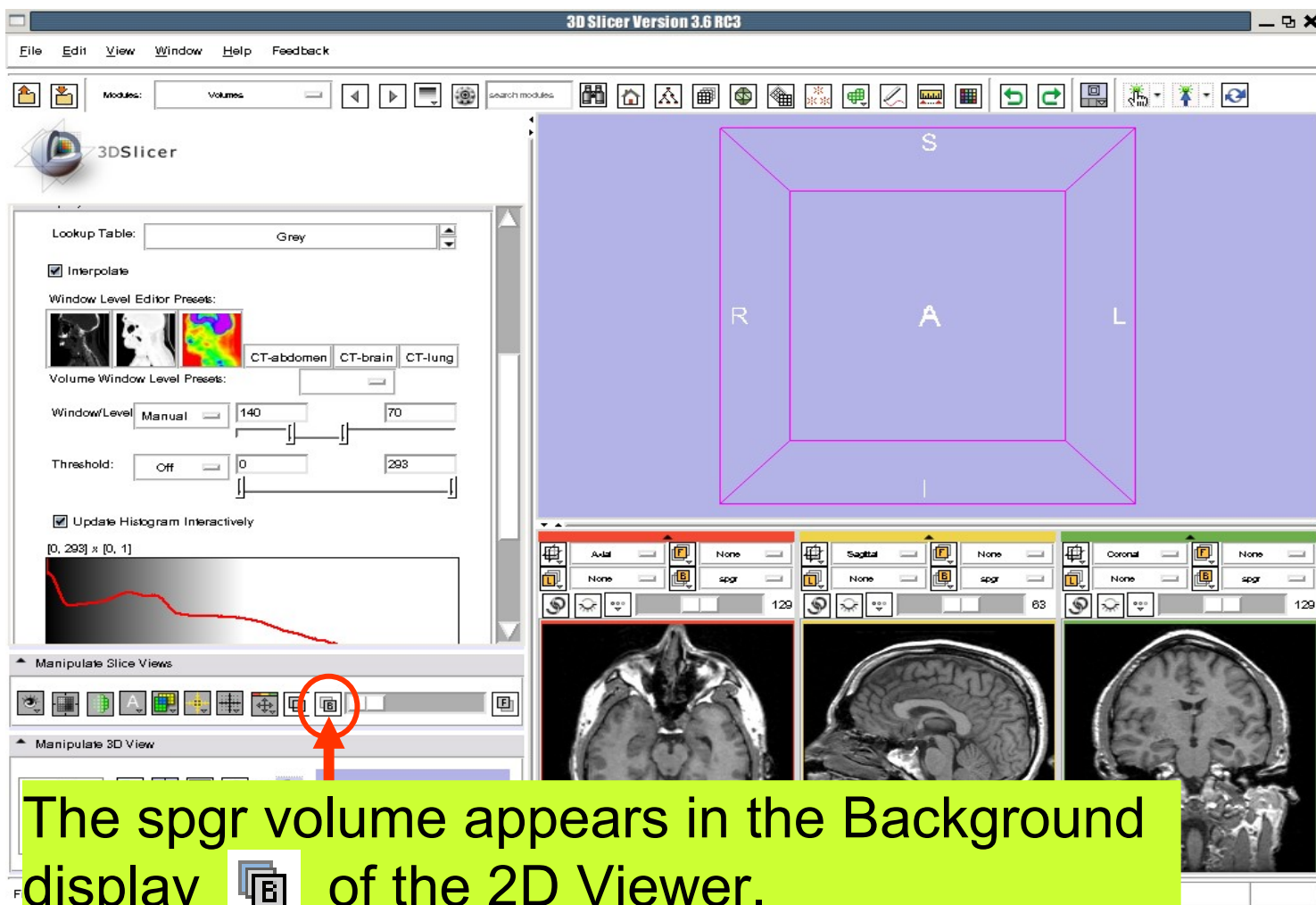
Browse to find the header file of the spgr volume  
spgr.nhdr located in the directory  
Slicer3VisualizationDataset/nrrd and click on Open.



# Loading Volumes

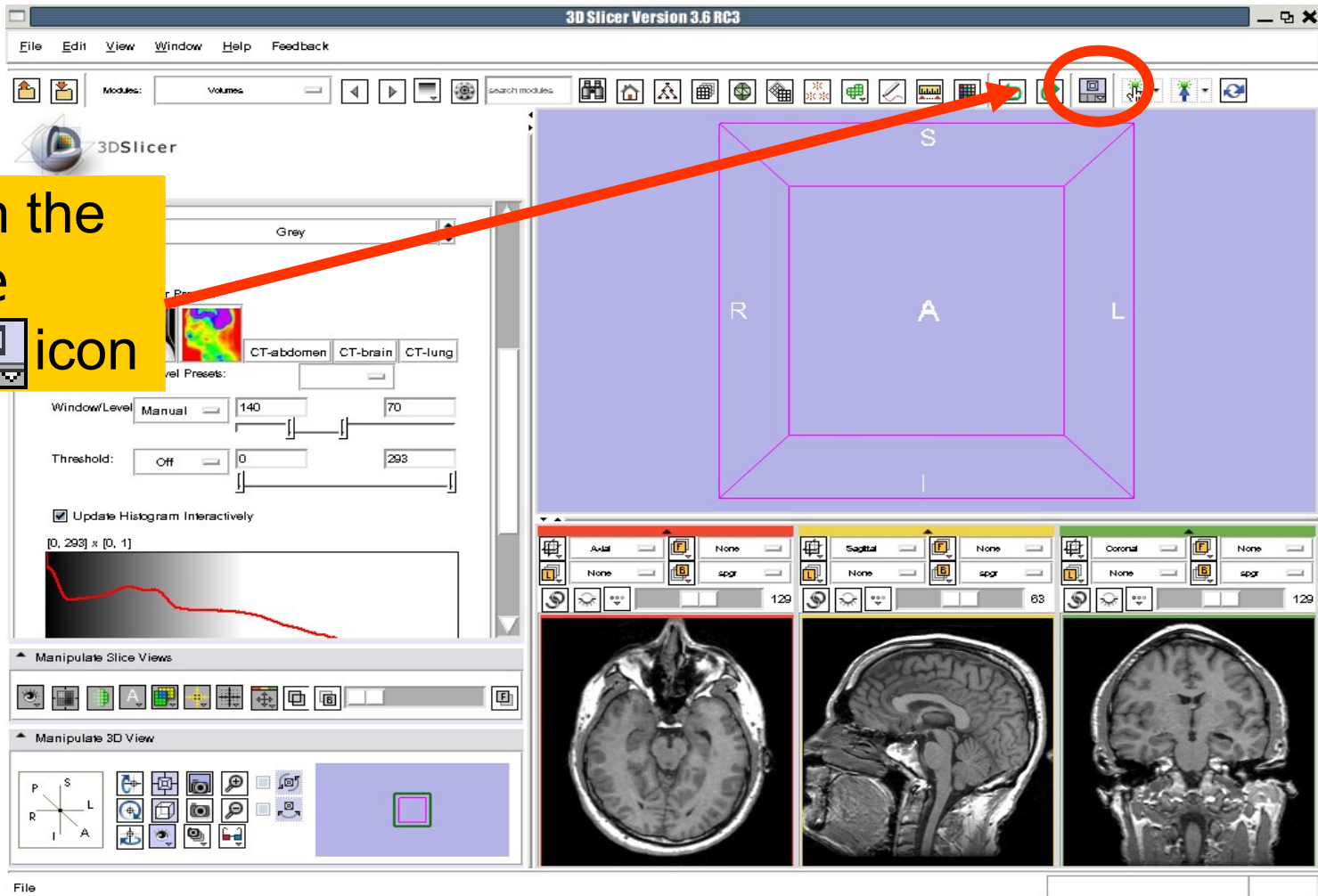


# Loading Volumes

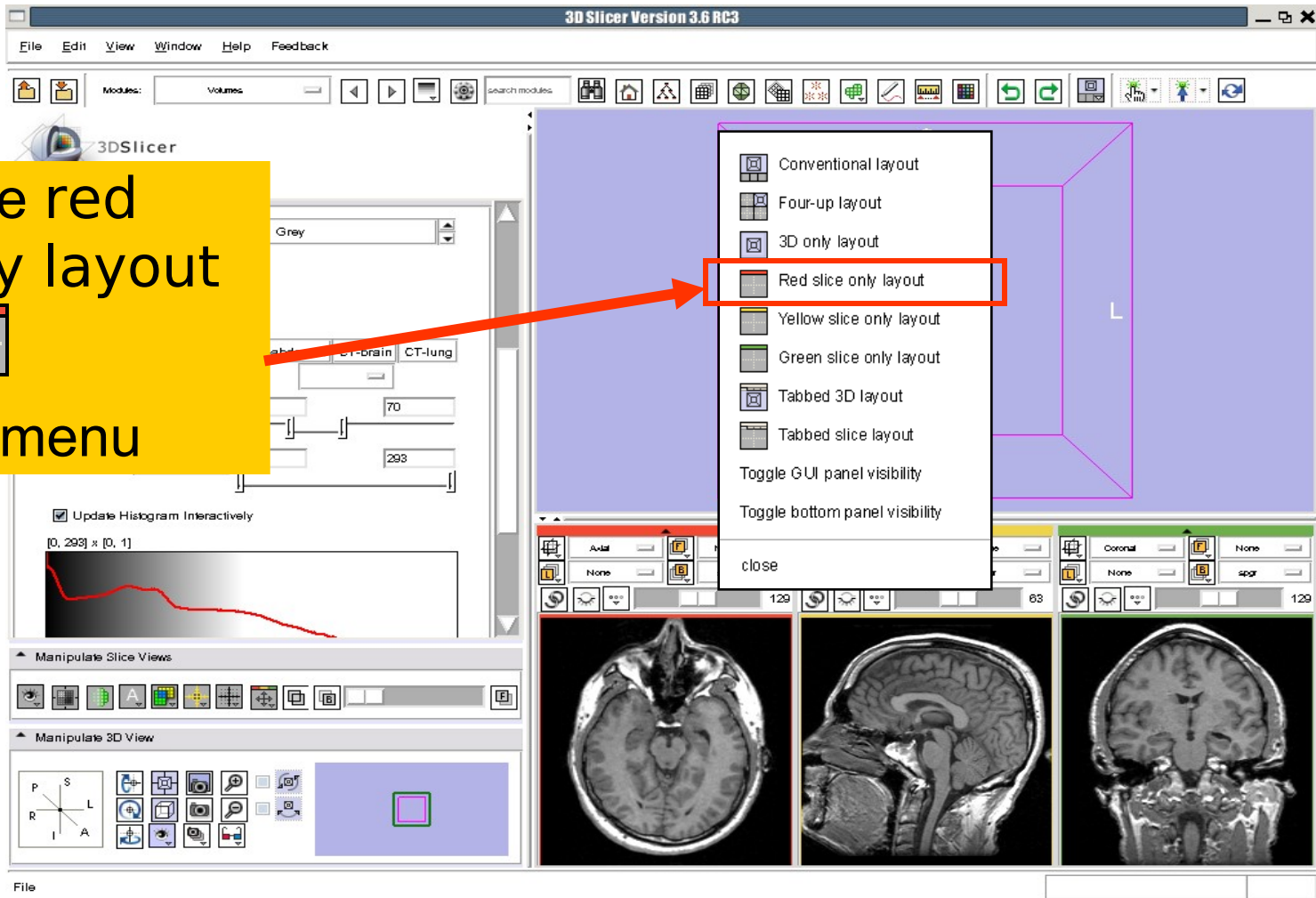


# Exploring the data

Click on the  
choose  
view icon

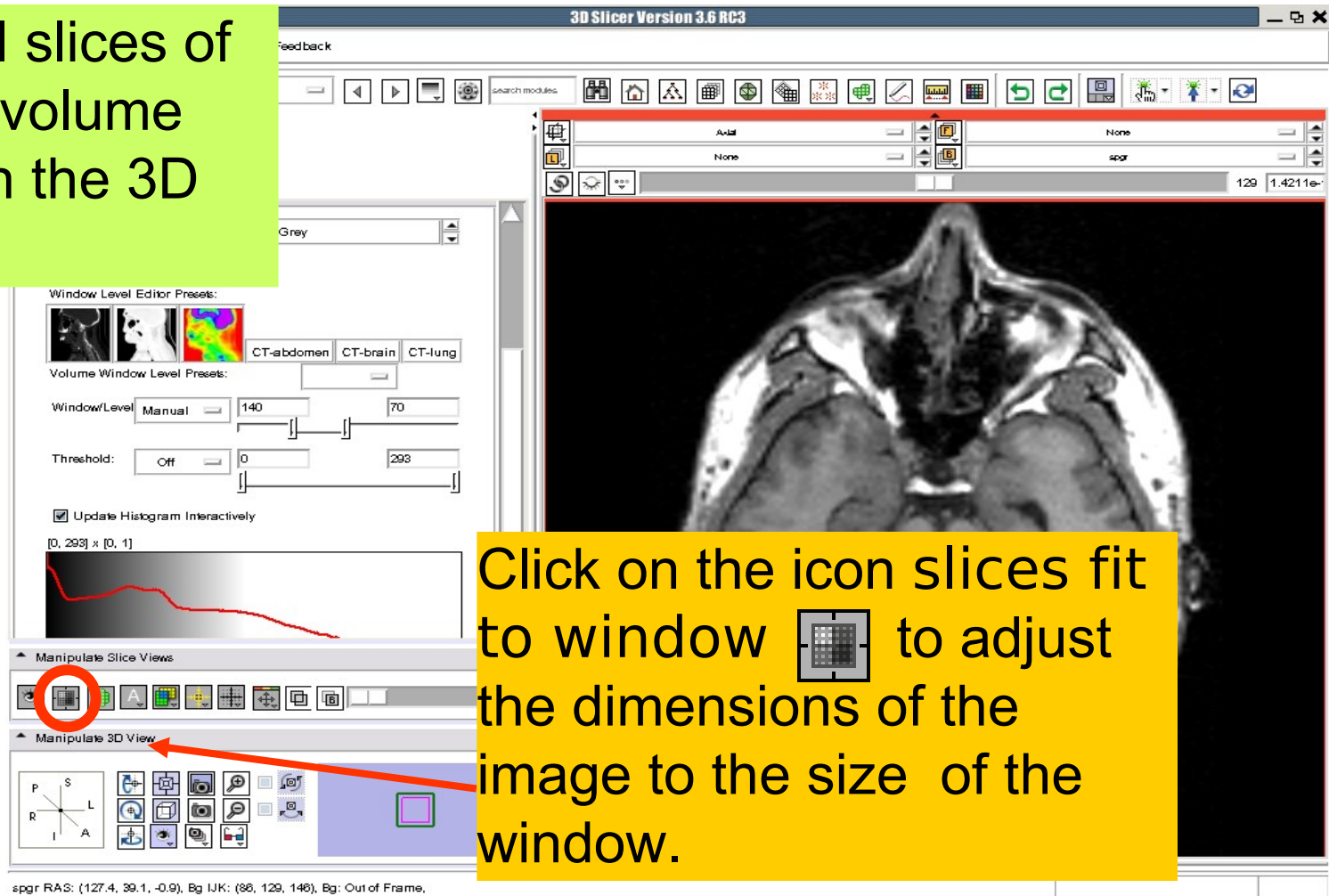


# Exploring the data



# Exploring the data

The axial slices of the spgr volume appear in the 3D viewer.



3D Slicer Version 3.6 RC3

Window Level Editor Presets:

Volume Window Level Presets:

Window/Level: Manual 140 70

Threshold: Off 0 293


☒ Update Histogram Interactively

[0, 293] x [0, 1]


Manipulate Slice Views

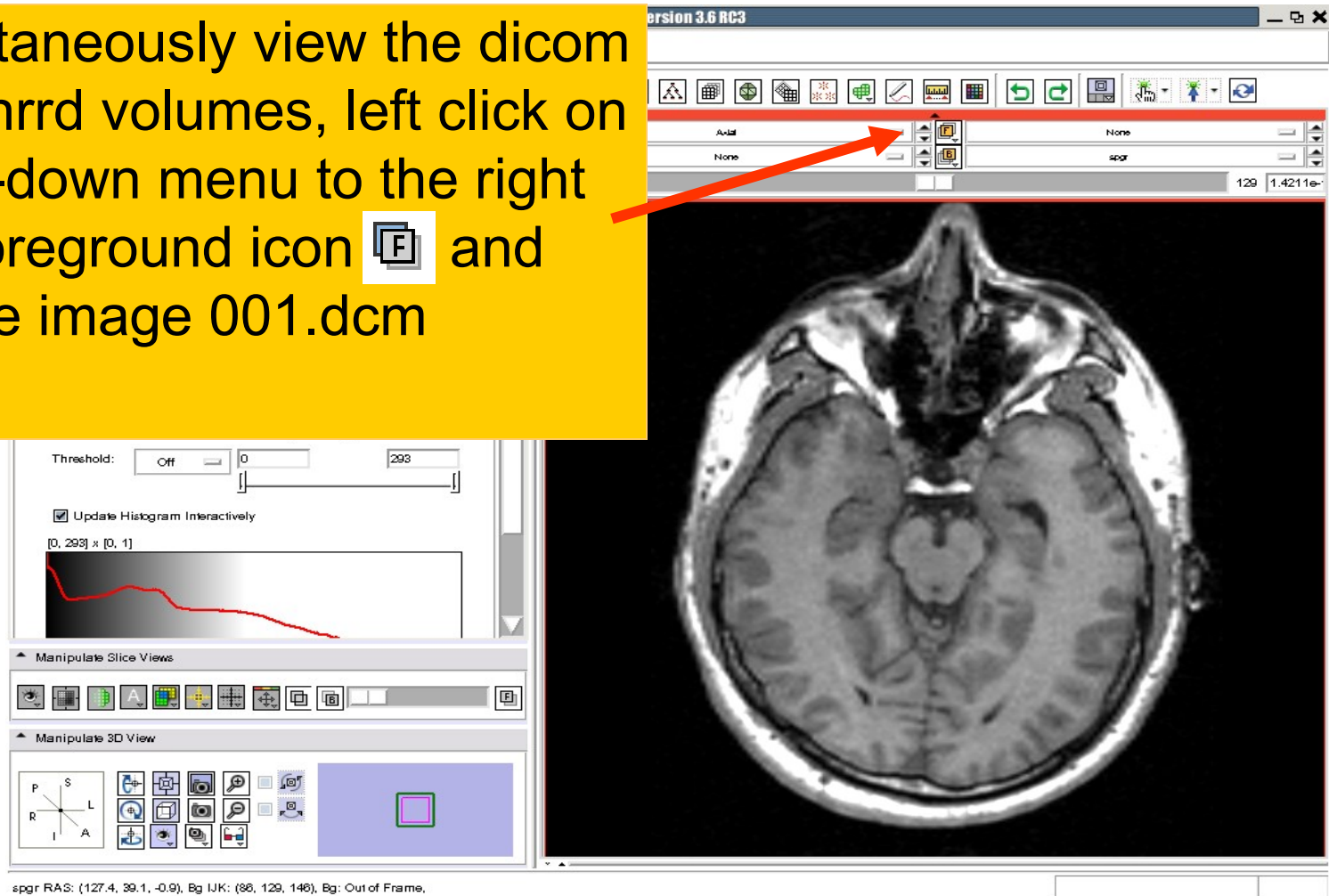
Manipulate 3D View

spgr RAS: (127.4, 39.1, -0.9), Bg LJK: (86, 129, 146), Bg: Out of Frame.

Click on the icon slices fit to window  to adjust the dimensions of the image to the size of the window.



# Exploring the data

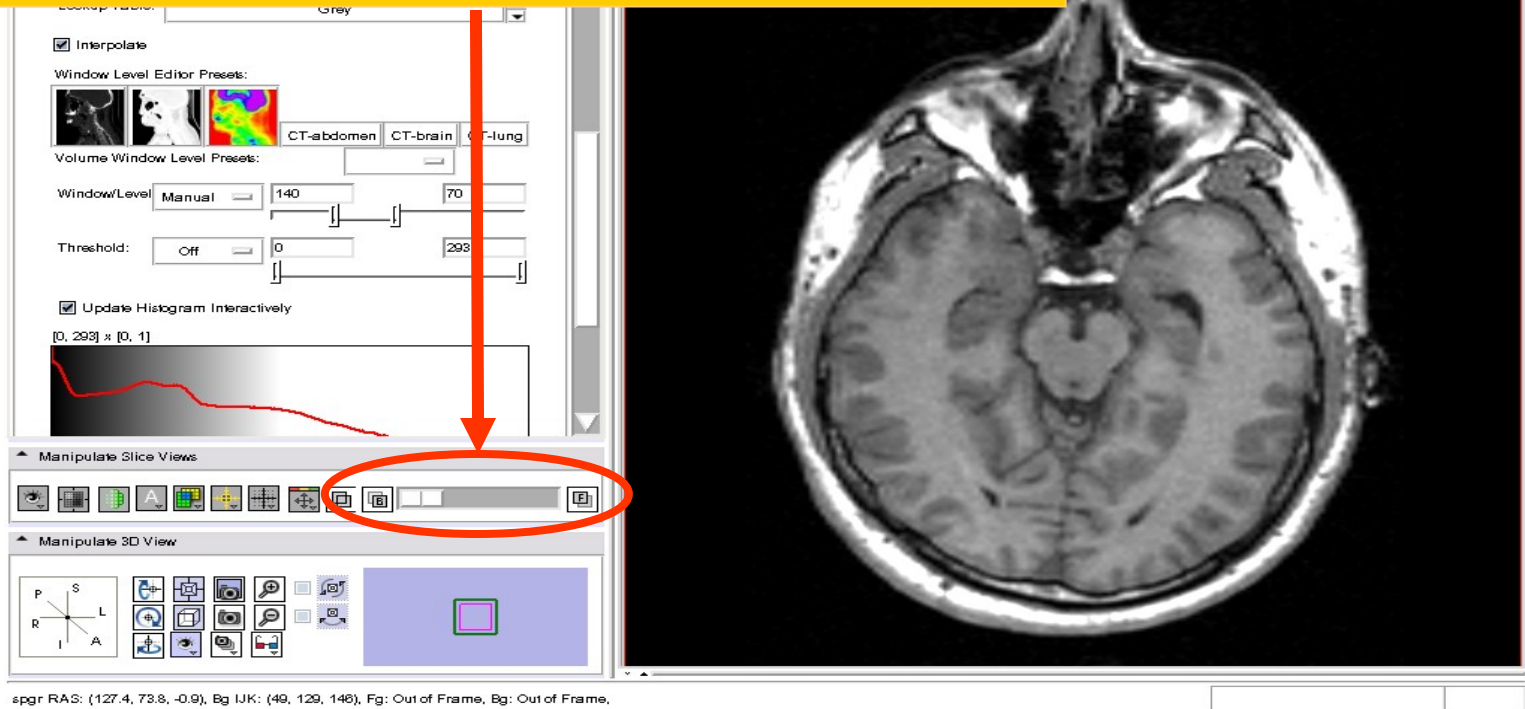
To simultaneously view the dicom and the nrrd volumes, left click on the drop-down menu to the right of the Foreground icon  and select the image 001.dcm





# Exploring the data

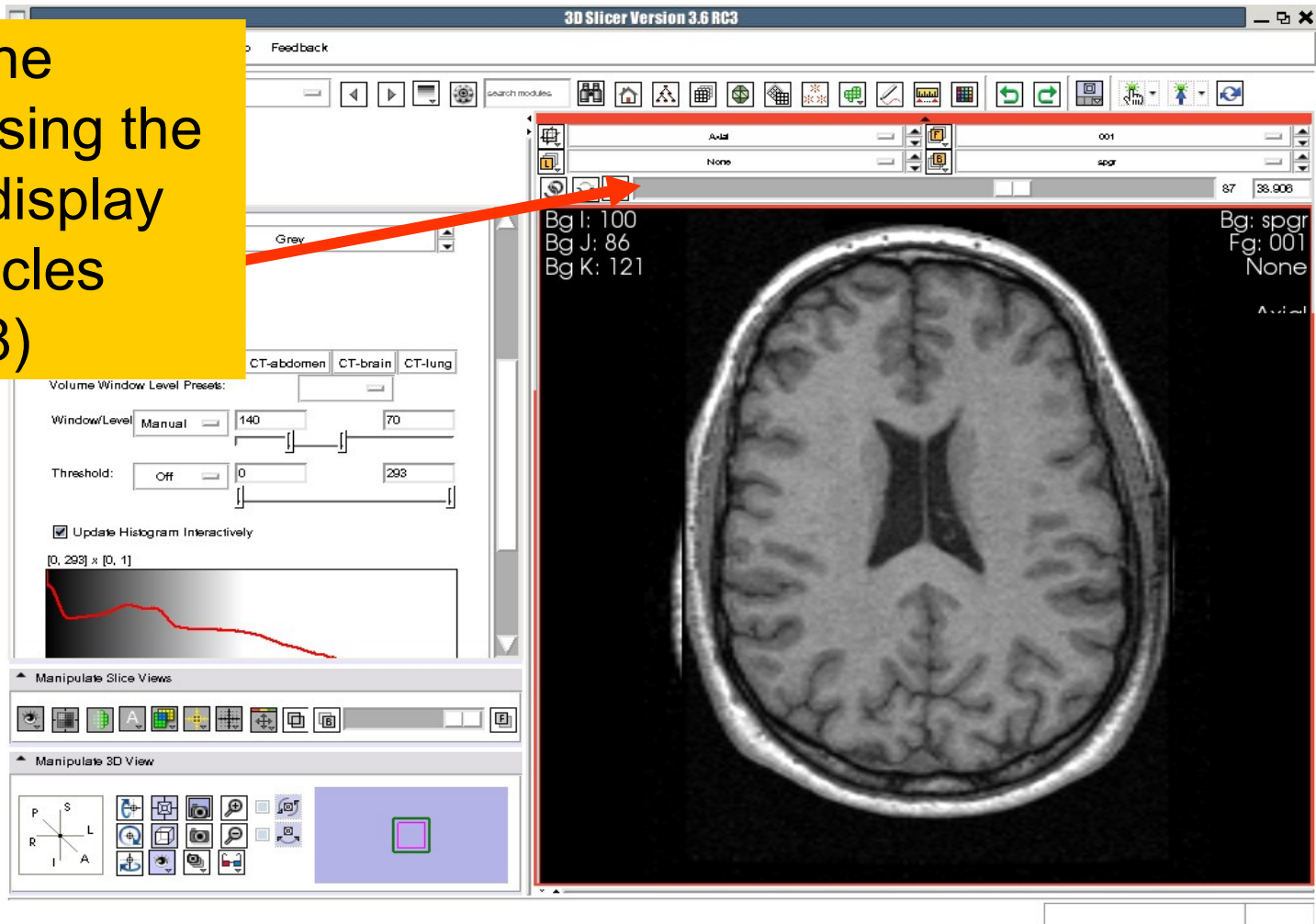
Click on the Background  icon or the Foreground  icon to display the spgr or the DICOM volumes in the Viewer





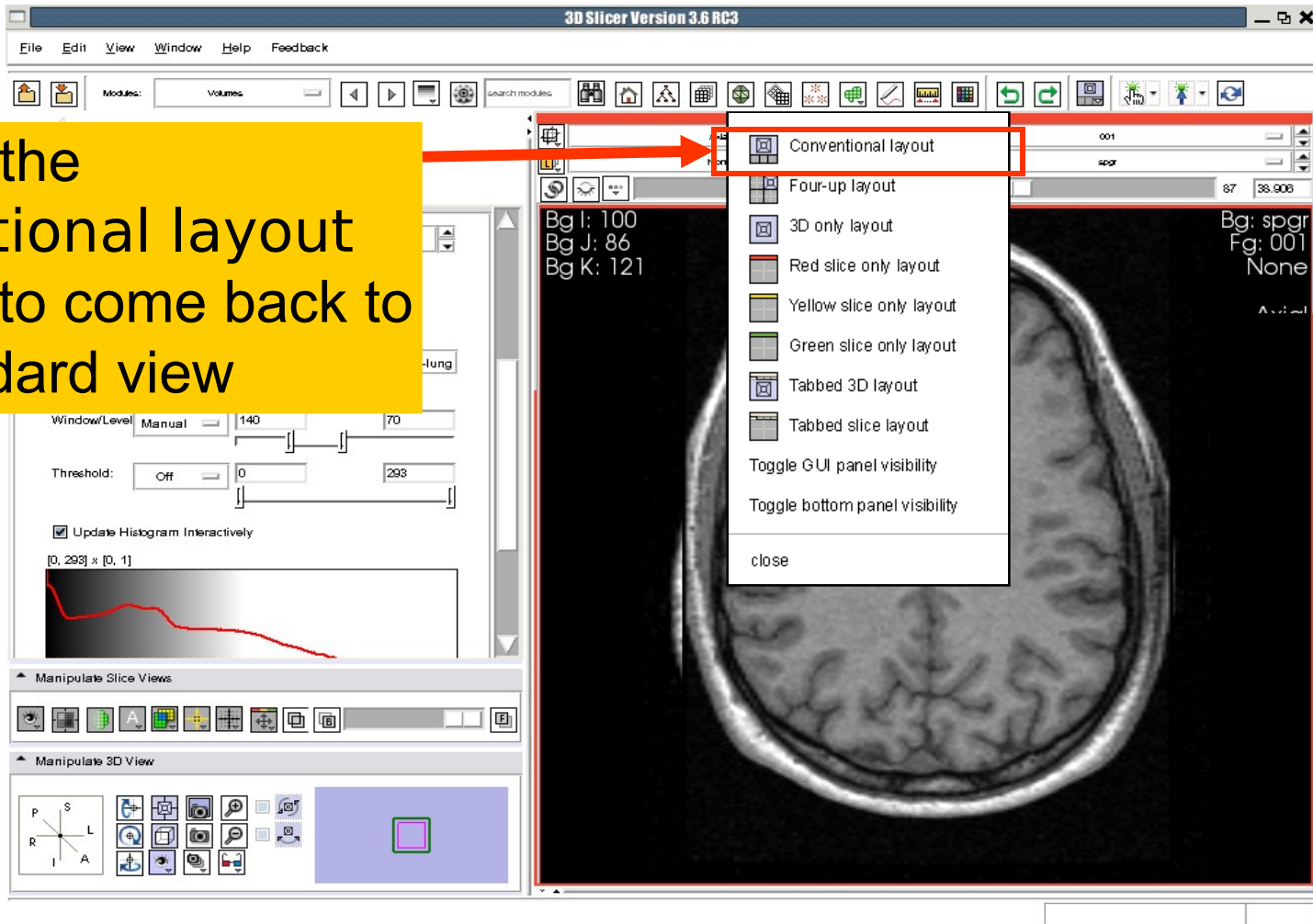
# Exploring the data

Browse the images using the slider to display the ventricles (~slice 38)




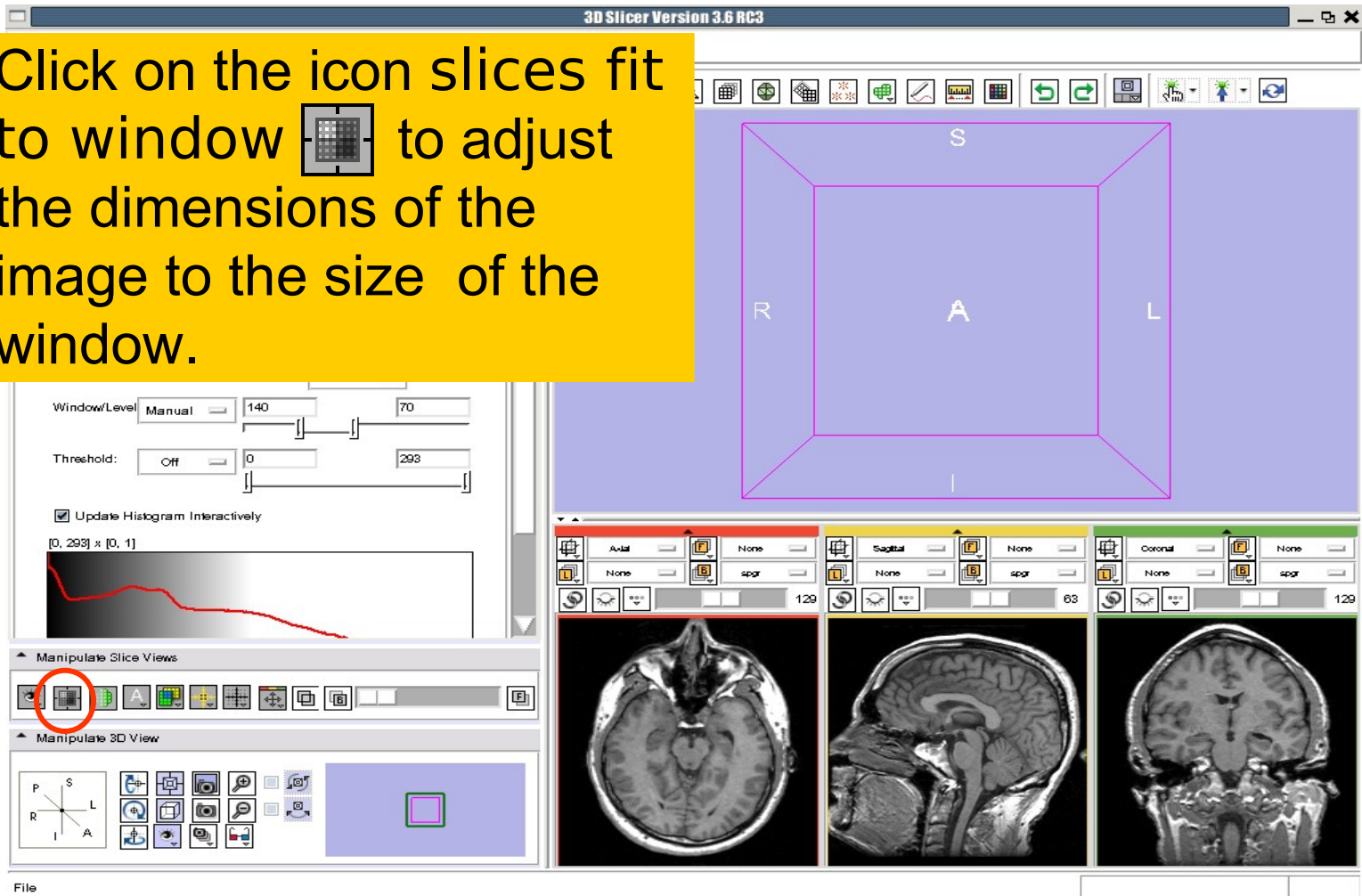
# Exploring the data

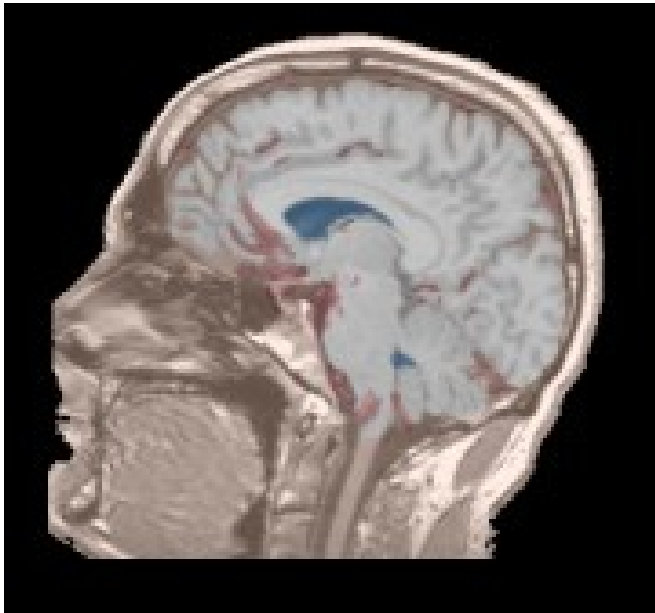
Click on the conventional layout icon  to come back to the standard view



# Loading Volumes

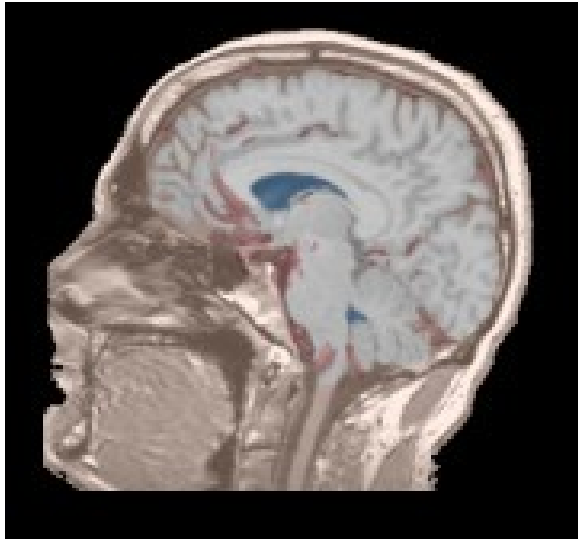
Click on the icon slices fit to window  to adjust the dimensions of the image to the size of the window.





## Part 2: Loading and visualizing segmented structures overlaid on grayscale images

# Label map

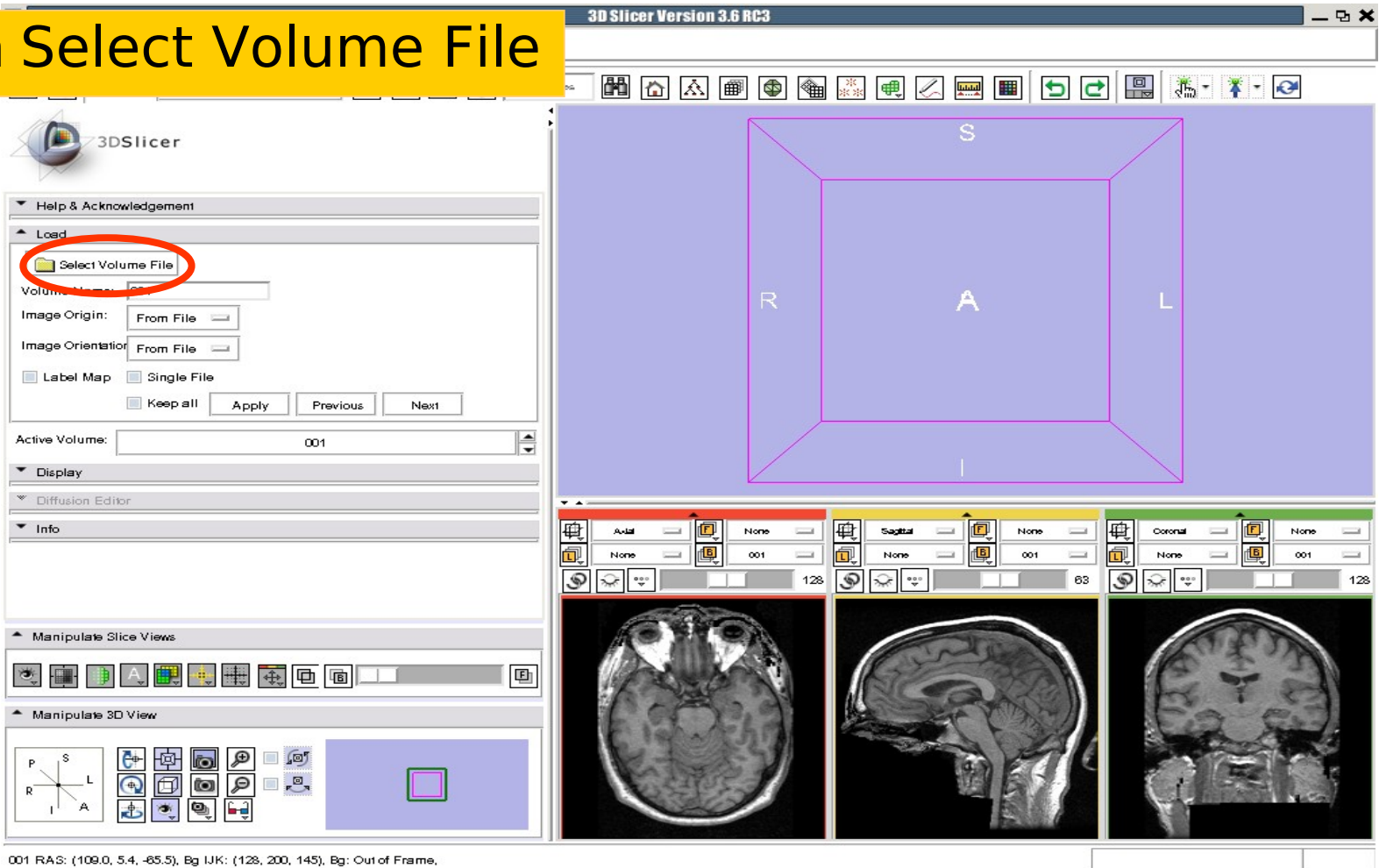


- **Image segmentation** is the extraction of structural information of particular interest from surrounding image.
- Each pixel is assigned a specific **label value** which corresponds to the anatomical structure that it belongs to.
- The three-dimensional result of the segmentation is a binary array called **label map**.

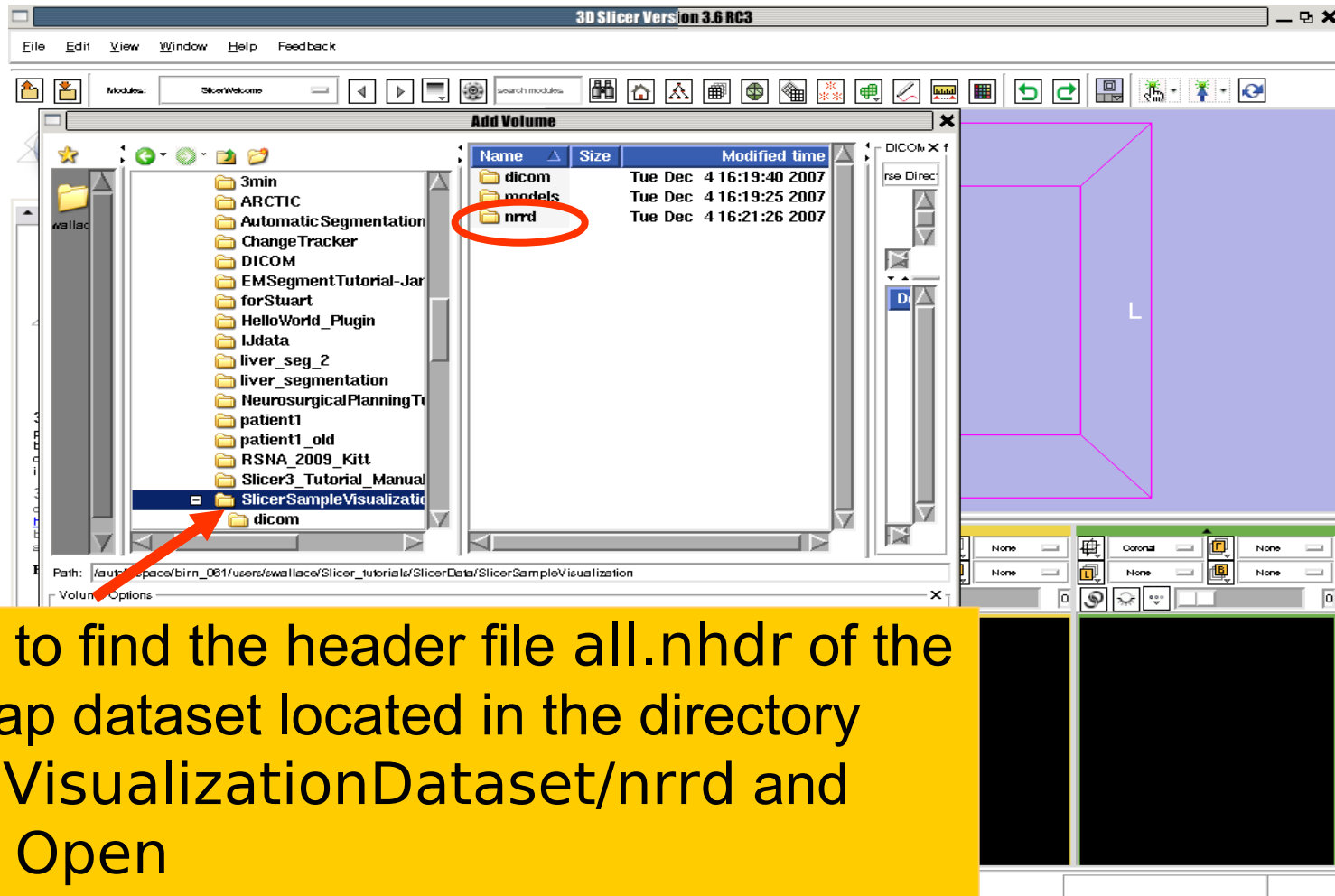


# Loading a label map

Click on Select Volume File

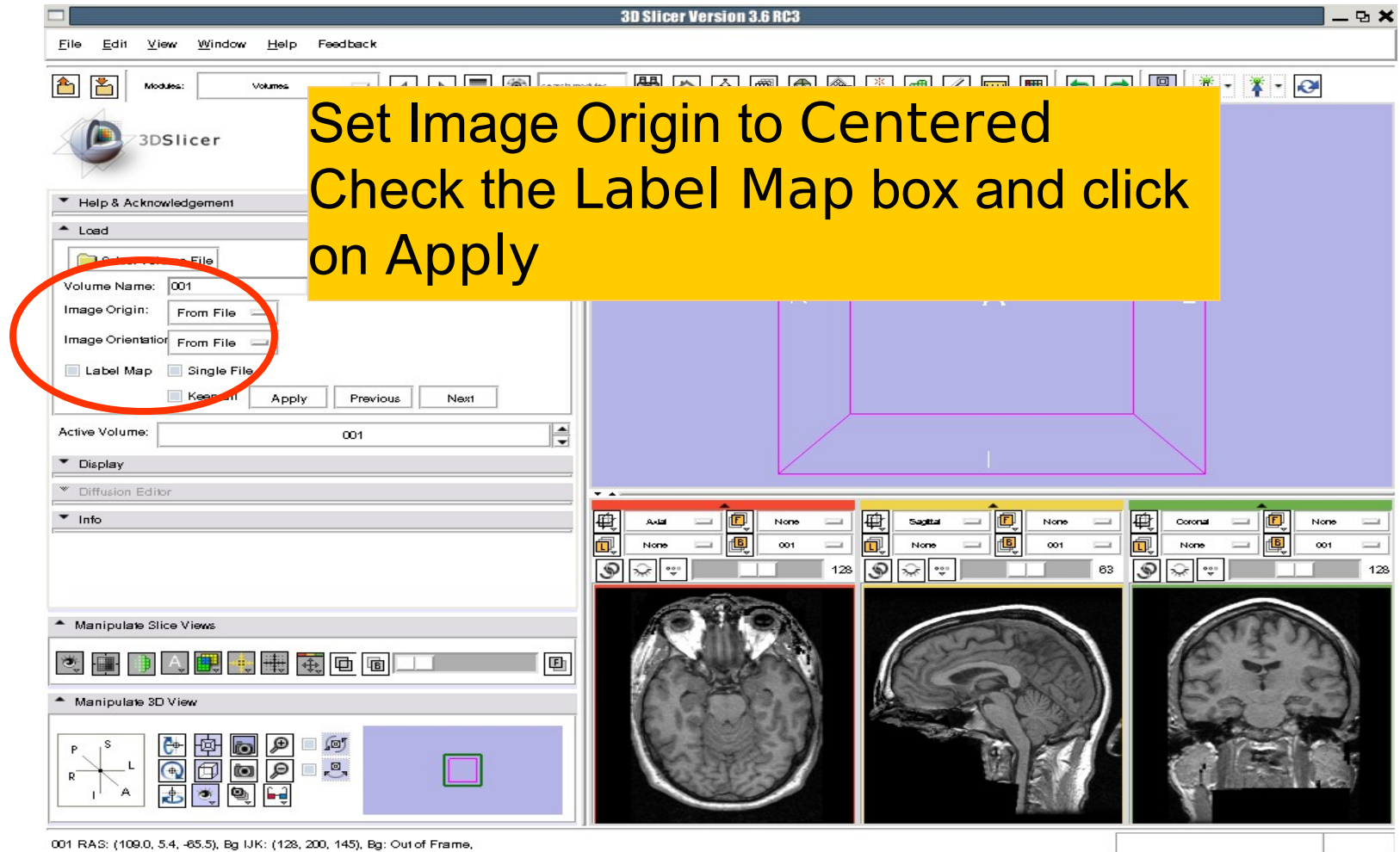


# Loading a label map





# Visualizing a label map

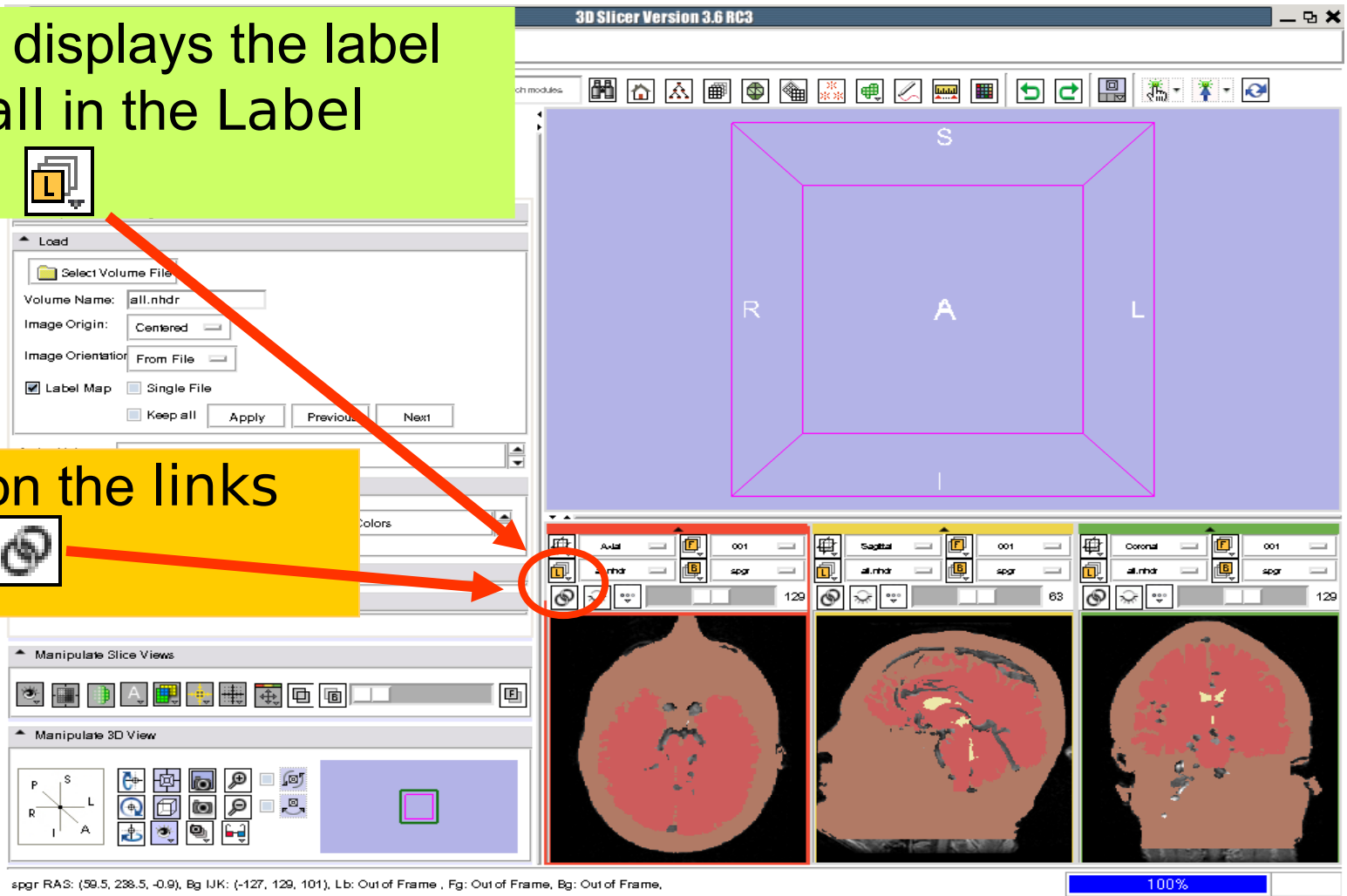


# Visualizing a label map

Slicer displays the label map all in the Label layer



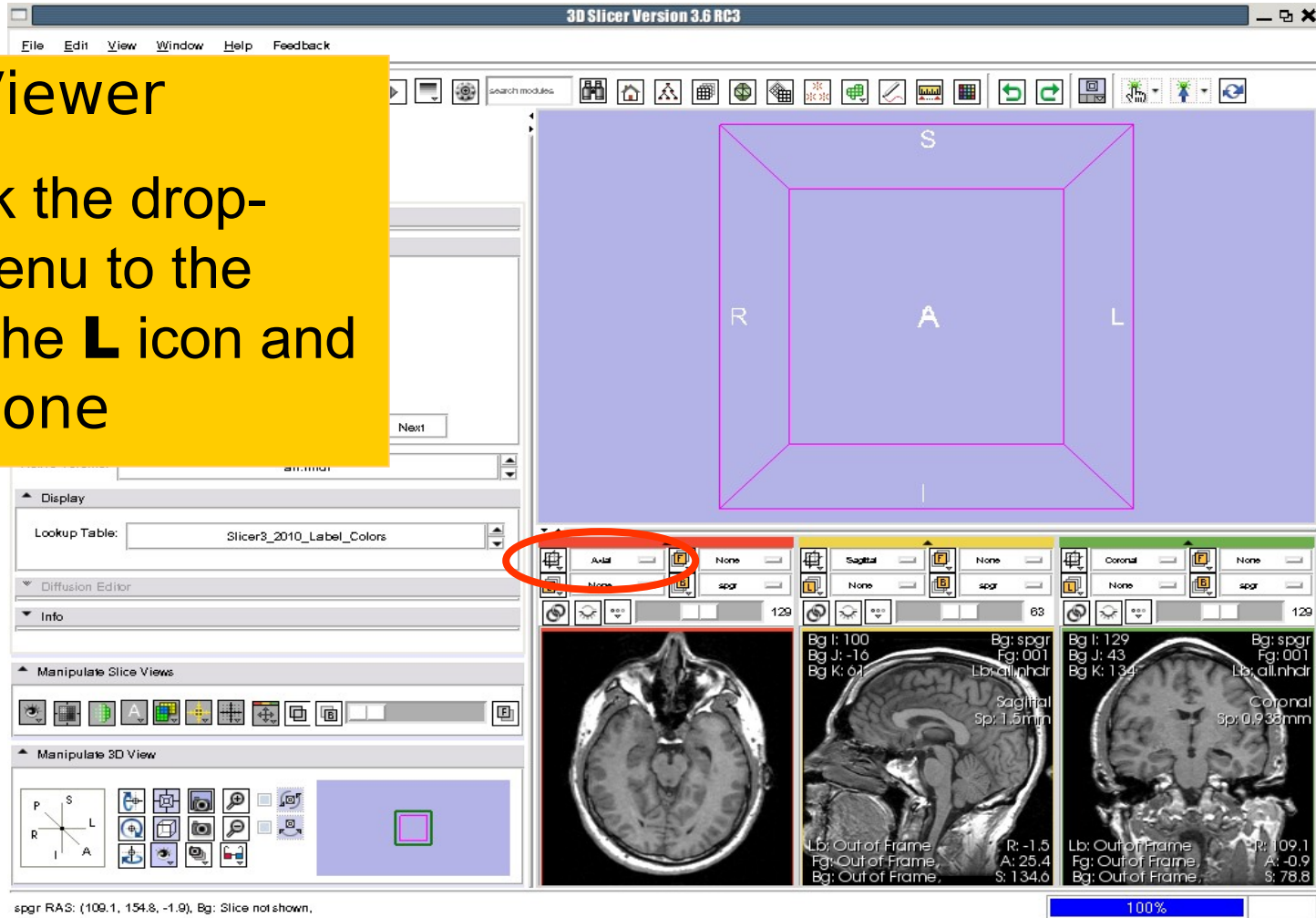
Click on the links icon.



# Visualizing Multiple Volumes

## Label Viewer

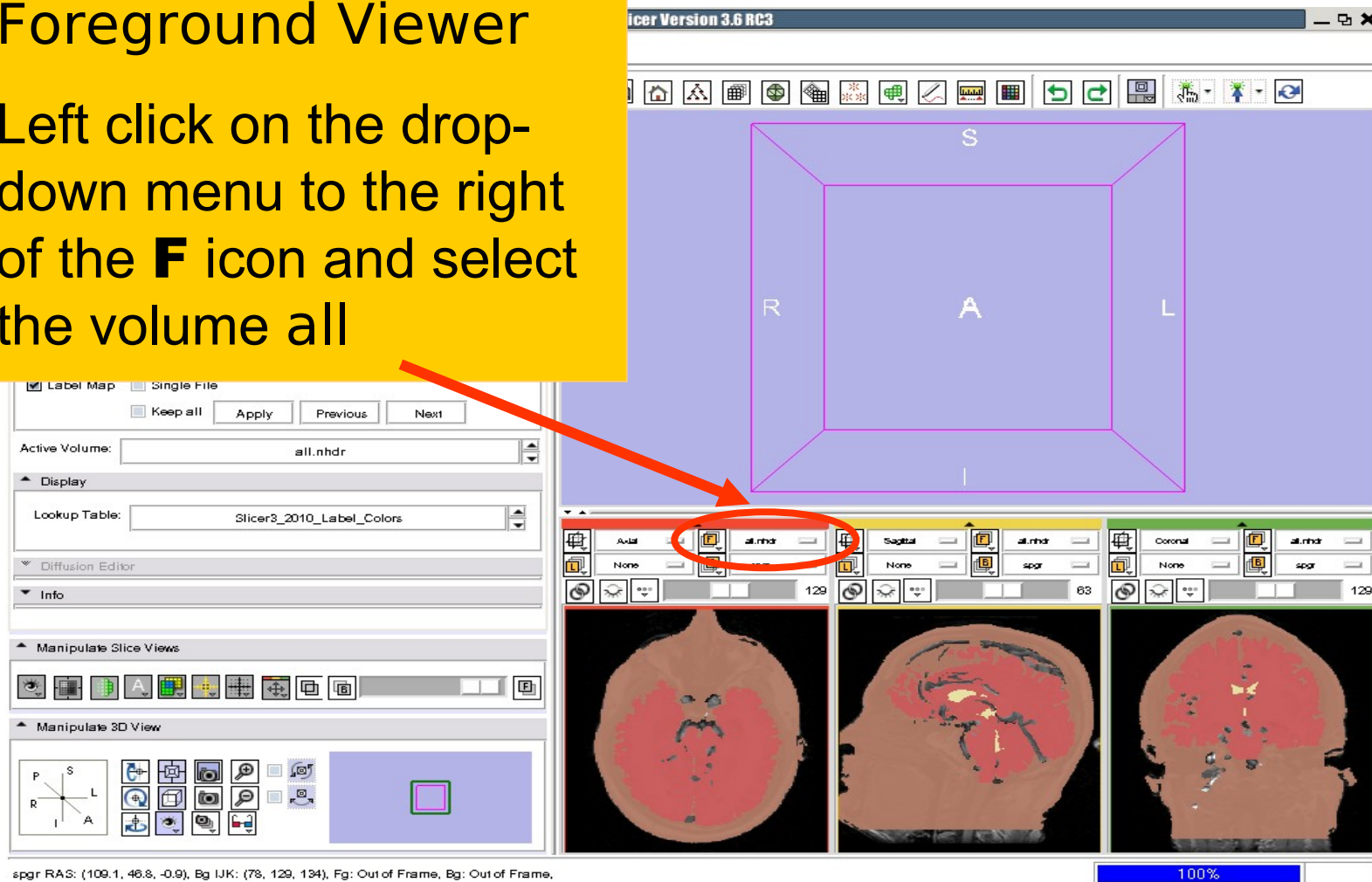
Left click the drop-down menu to the right of the **L** icon and select None



# Visualizing Multiple Volumes

## Foreground Viewer

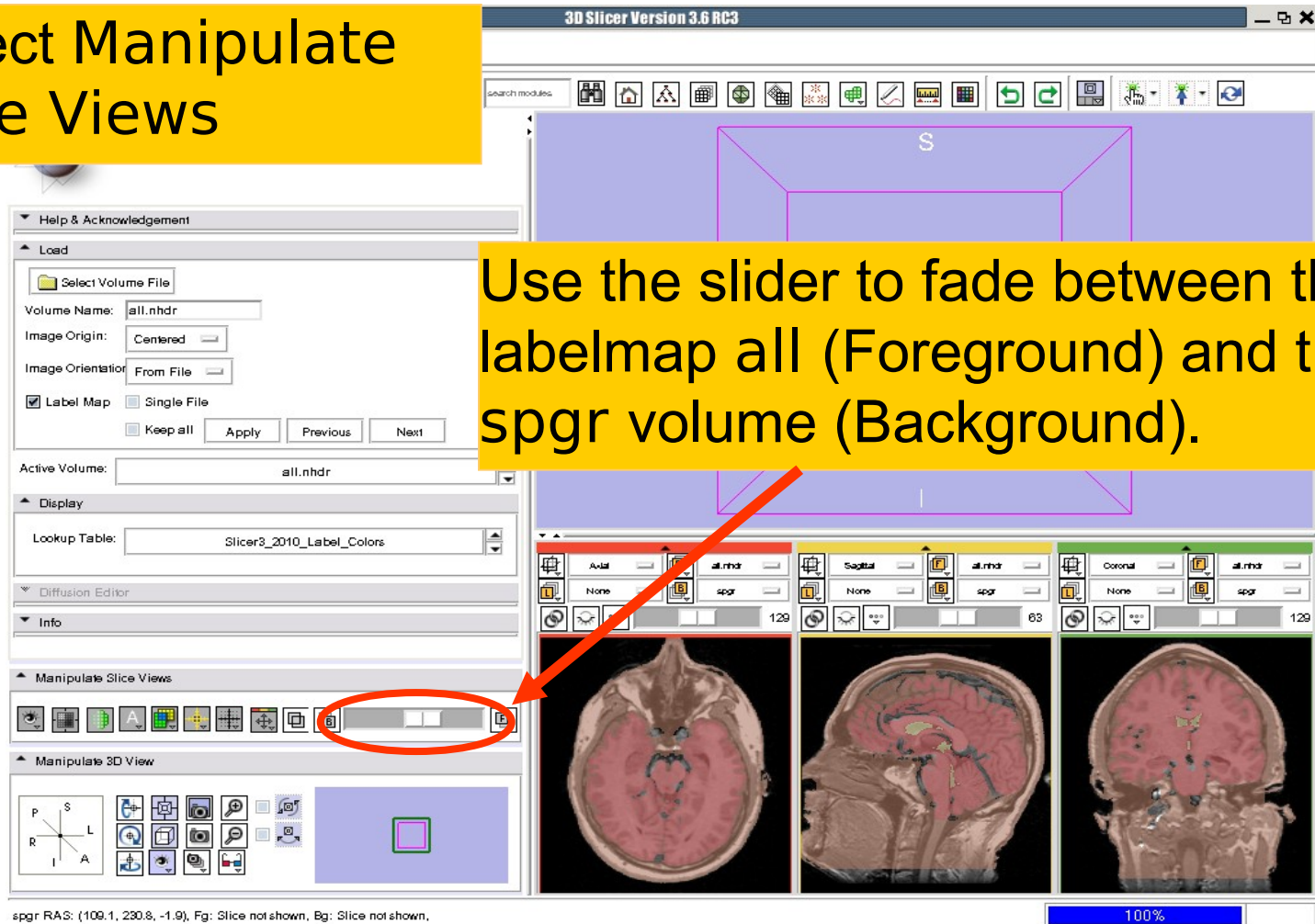
Left click on the drop-down menu to the right of the **F** icon and select the volume all



# Visualizing Multiple Volumes

Select Manipulate  
Slice Views

Use the slider to fade between the labelmap all (Foreground) and the spgr volume (Background).

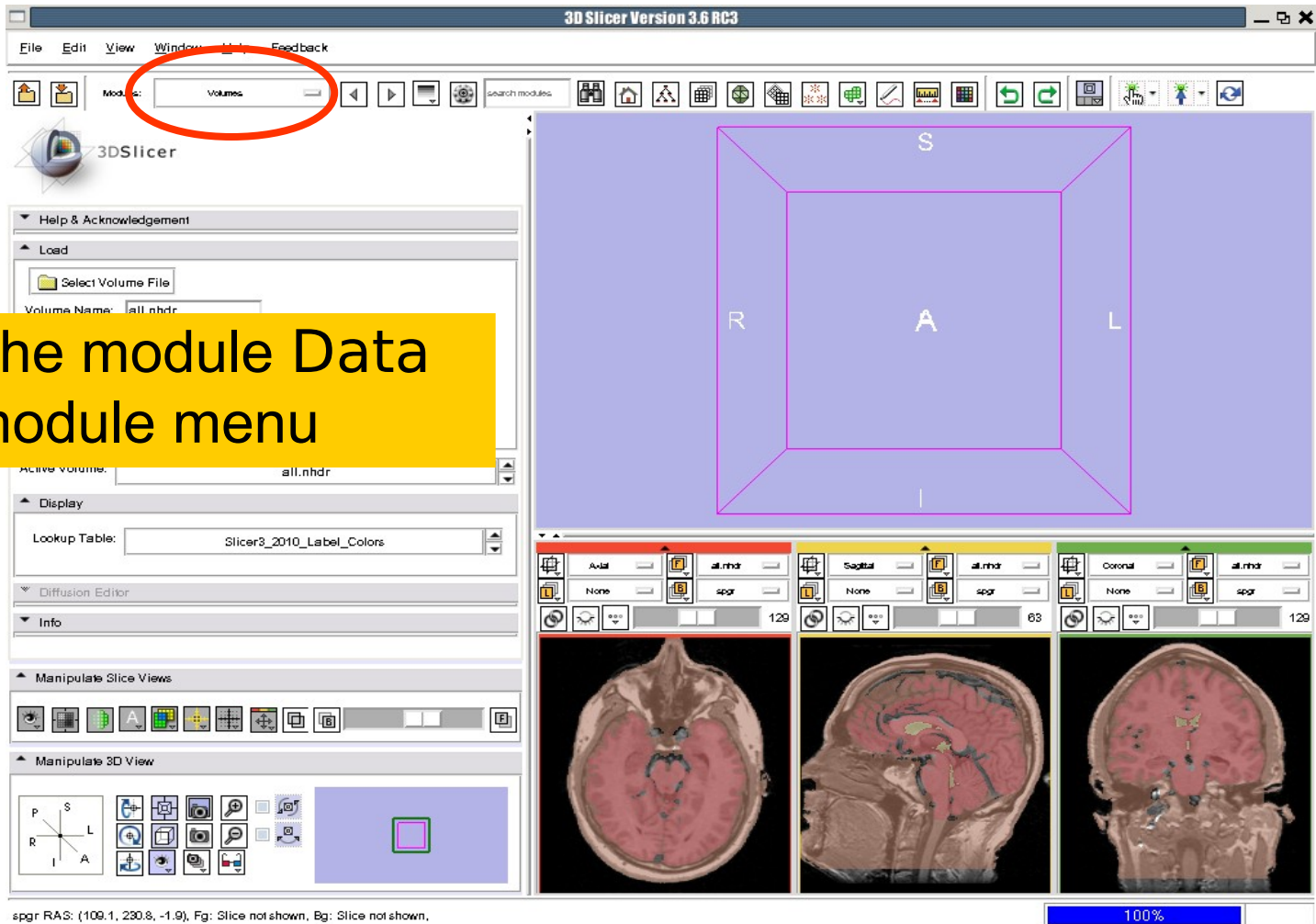


spgr RAS: (109.1, 230.8, -1.9), Fg: Slice not shown, Bg: Slice not shown.

100%

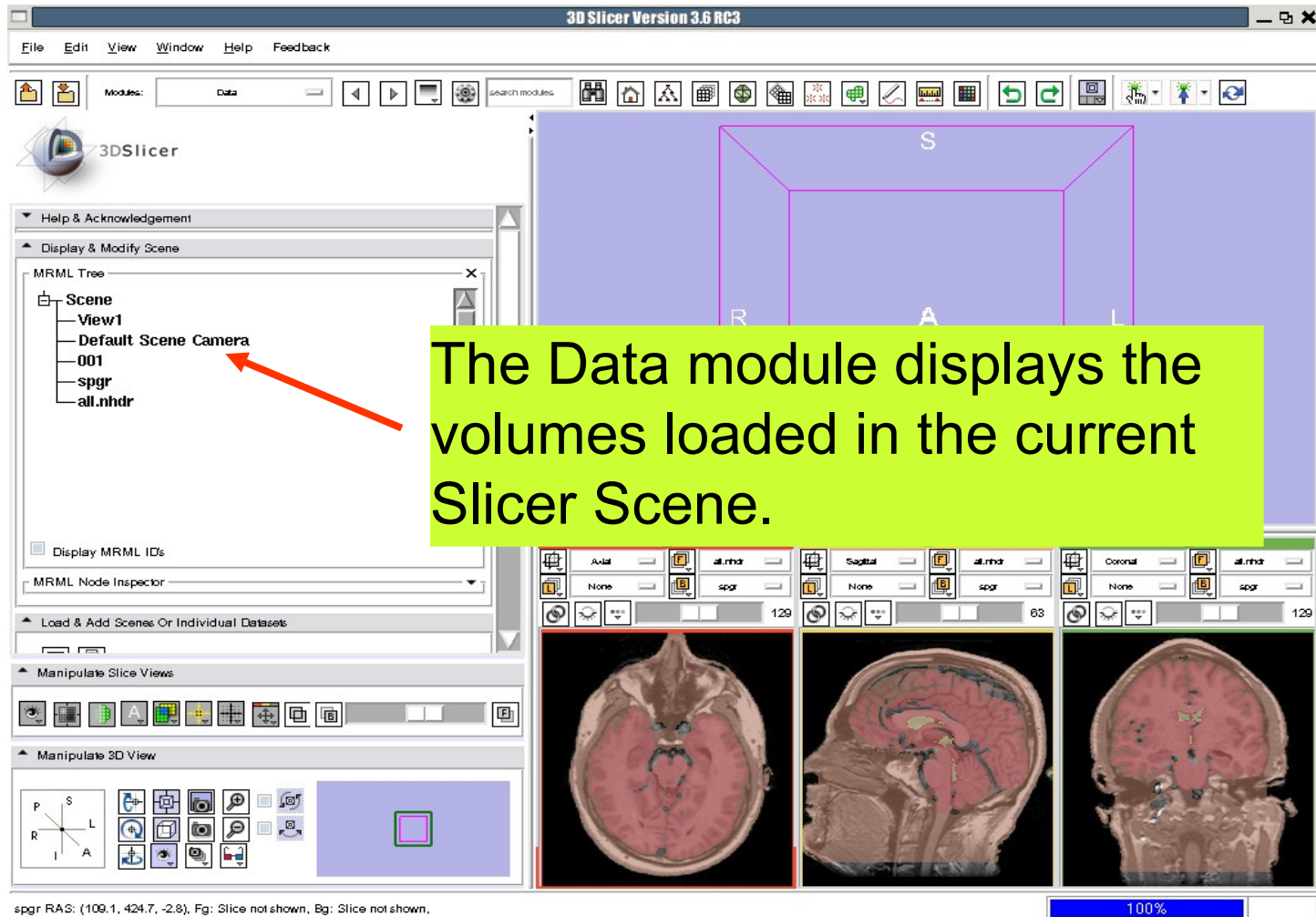
# 3D Visualization

Select the module Data in the module menu



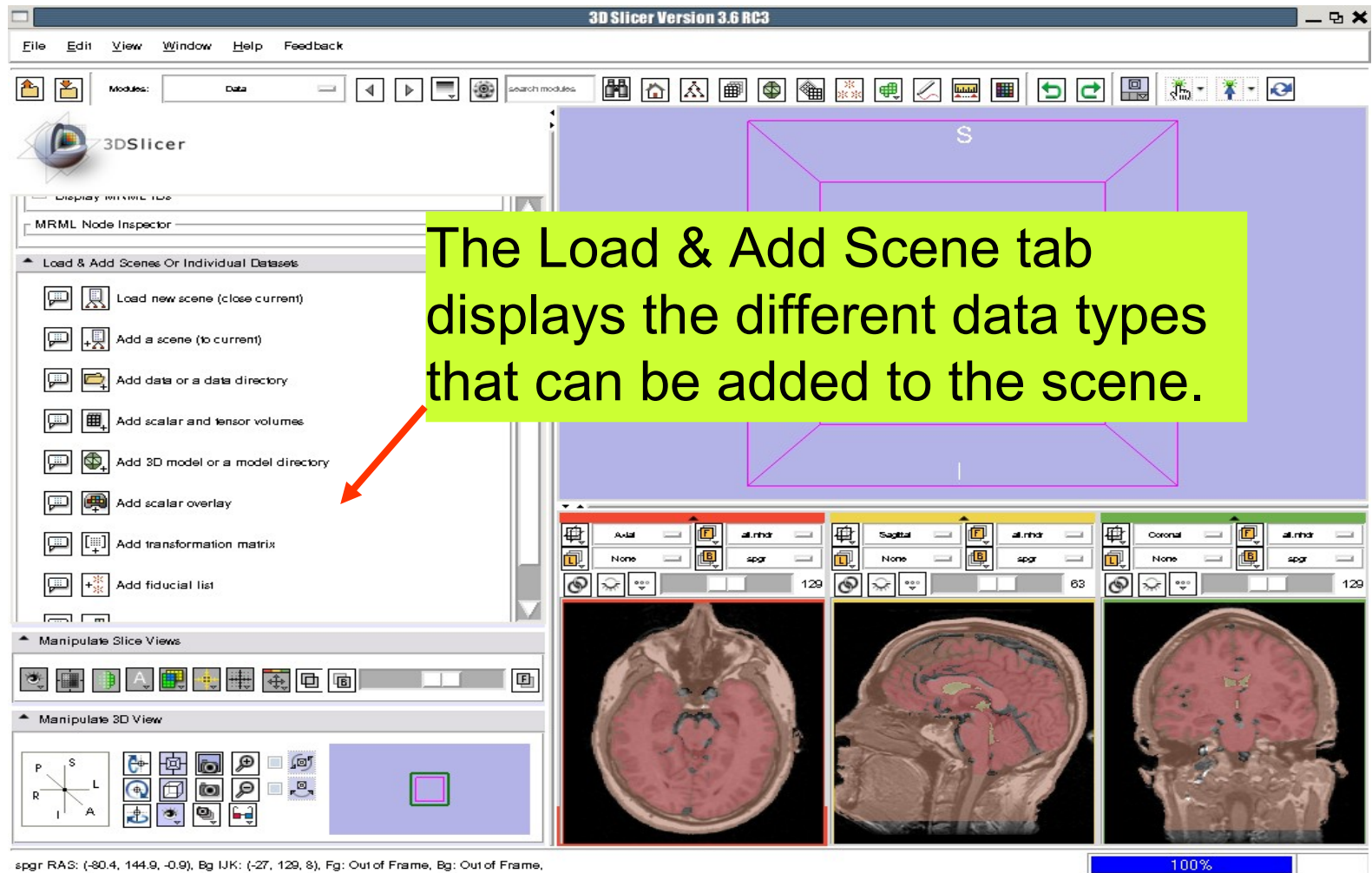


# 3D Visualization





# 3D Visualization

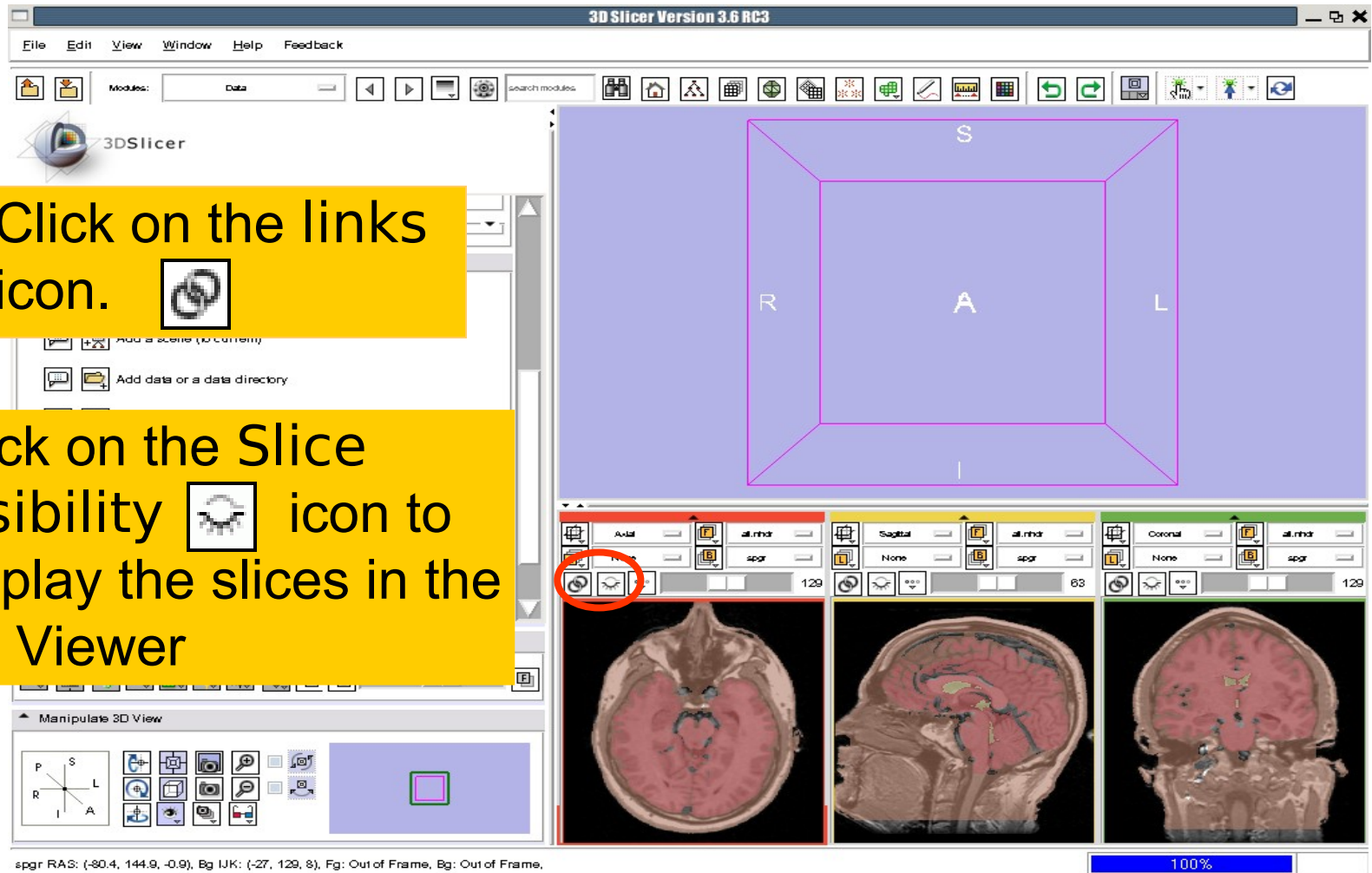


# 3D Visualization

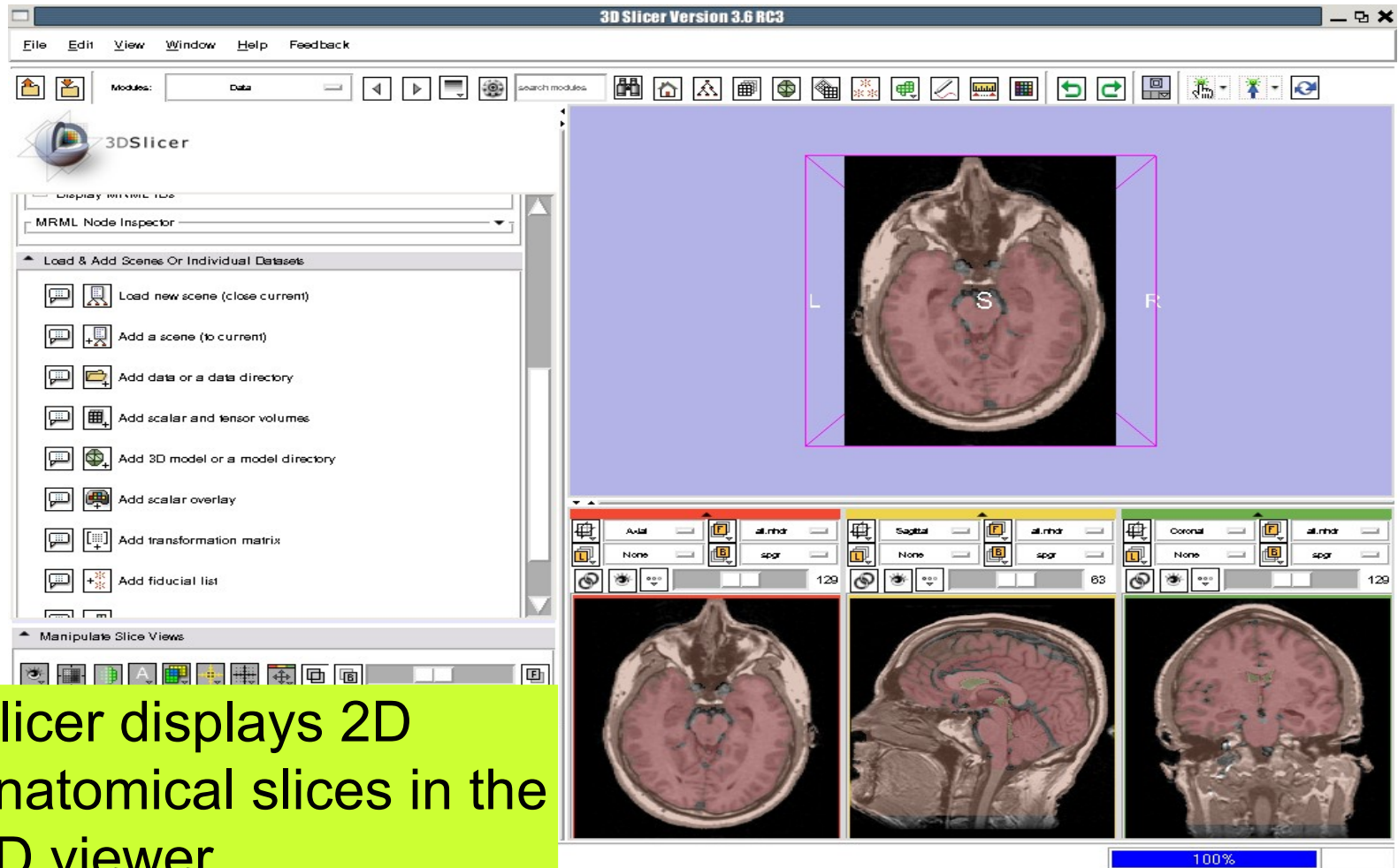
Click on the links icon.



Click on the Slice Visibility icon to display the slices in the 3D Viewer



# 3D Visualization

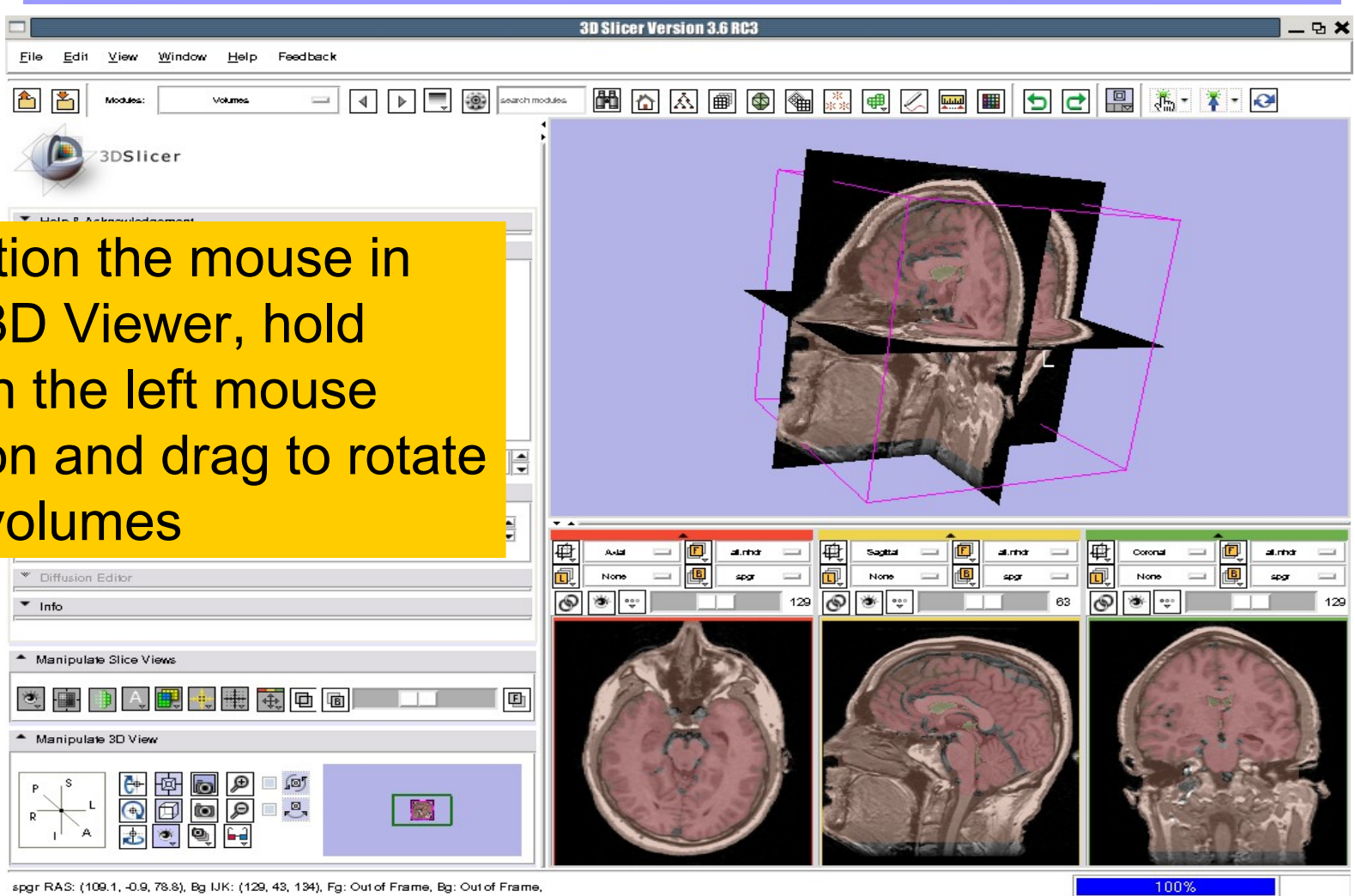


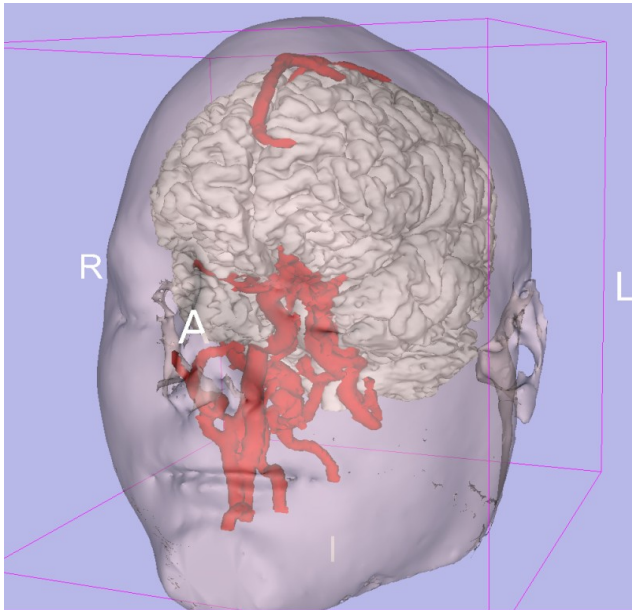
Slicer displays 2D anatomical slices in the 3D viewer



# 3D Visualization

Position the mouse in the 3D Viewer, hold down the left mouse button and drag to rotate the volumes

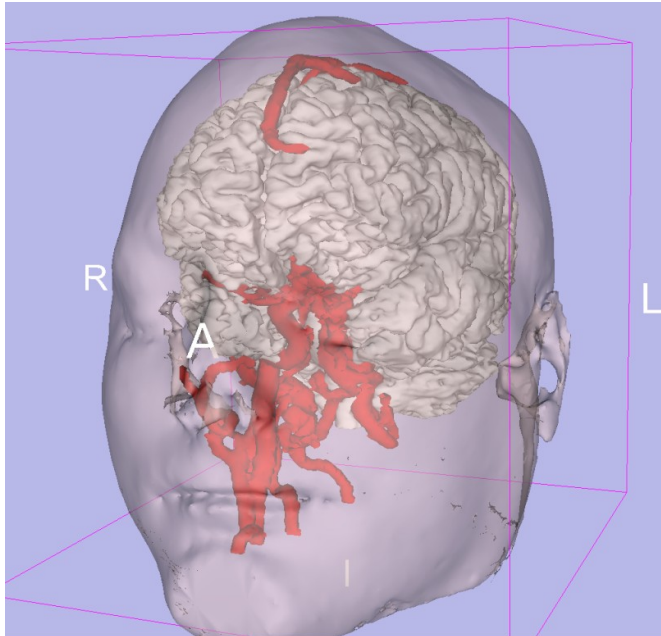




## Part 3: Loading and visualizing 3D models of the anatomy



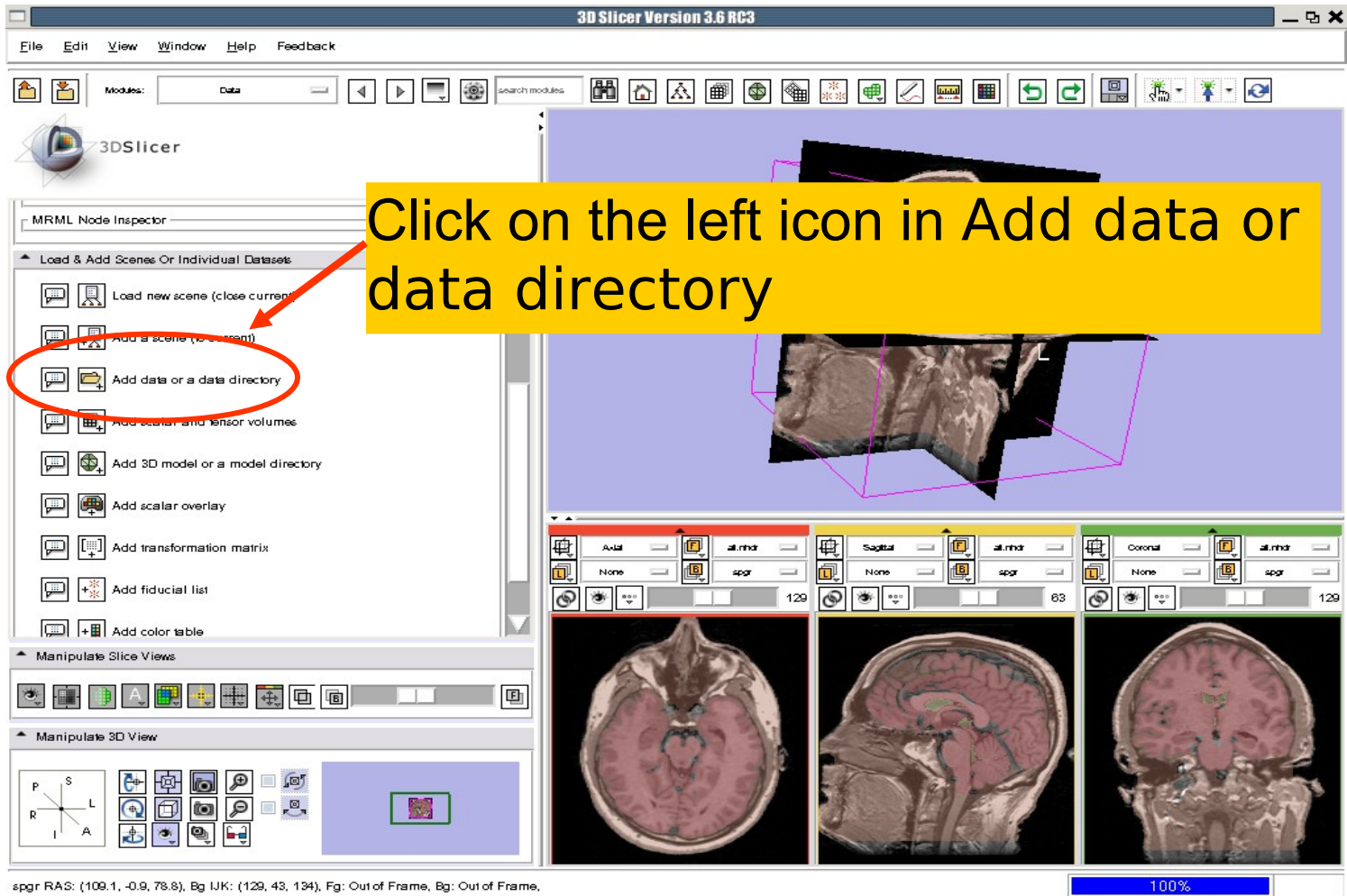
# 3D models



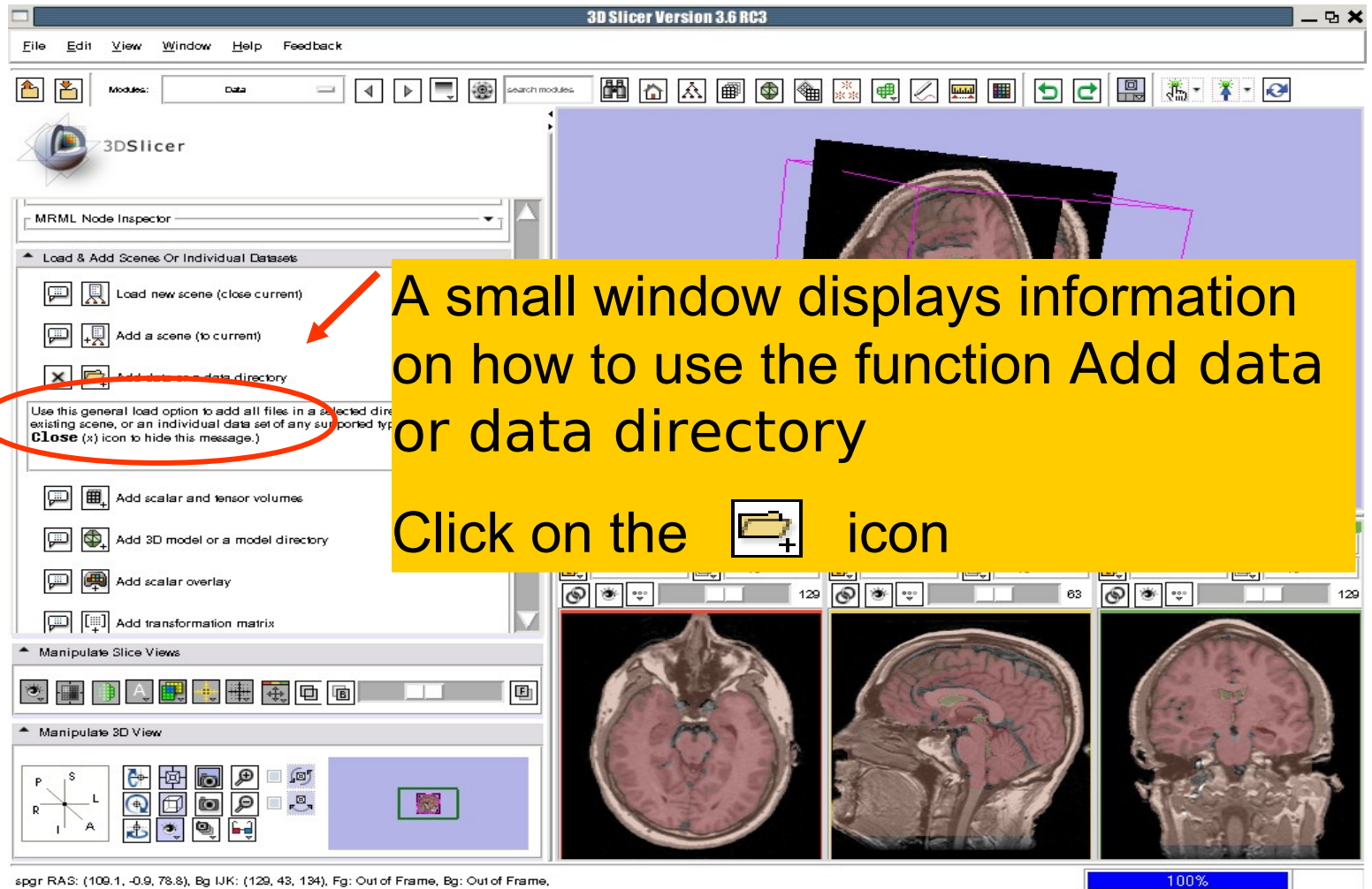
- A **3D model** is a surface reconstruction of an anatomical structure.
- The model is a **triangular mesh** that approximates a surface from a 3D label map.
- The scalar values for surface models are integers which correspond to the **label** that had been assigned in the segmentation process.



# 3D Visualization

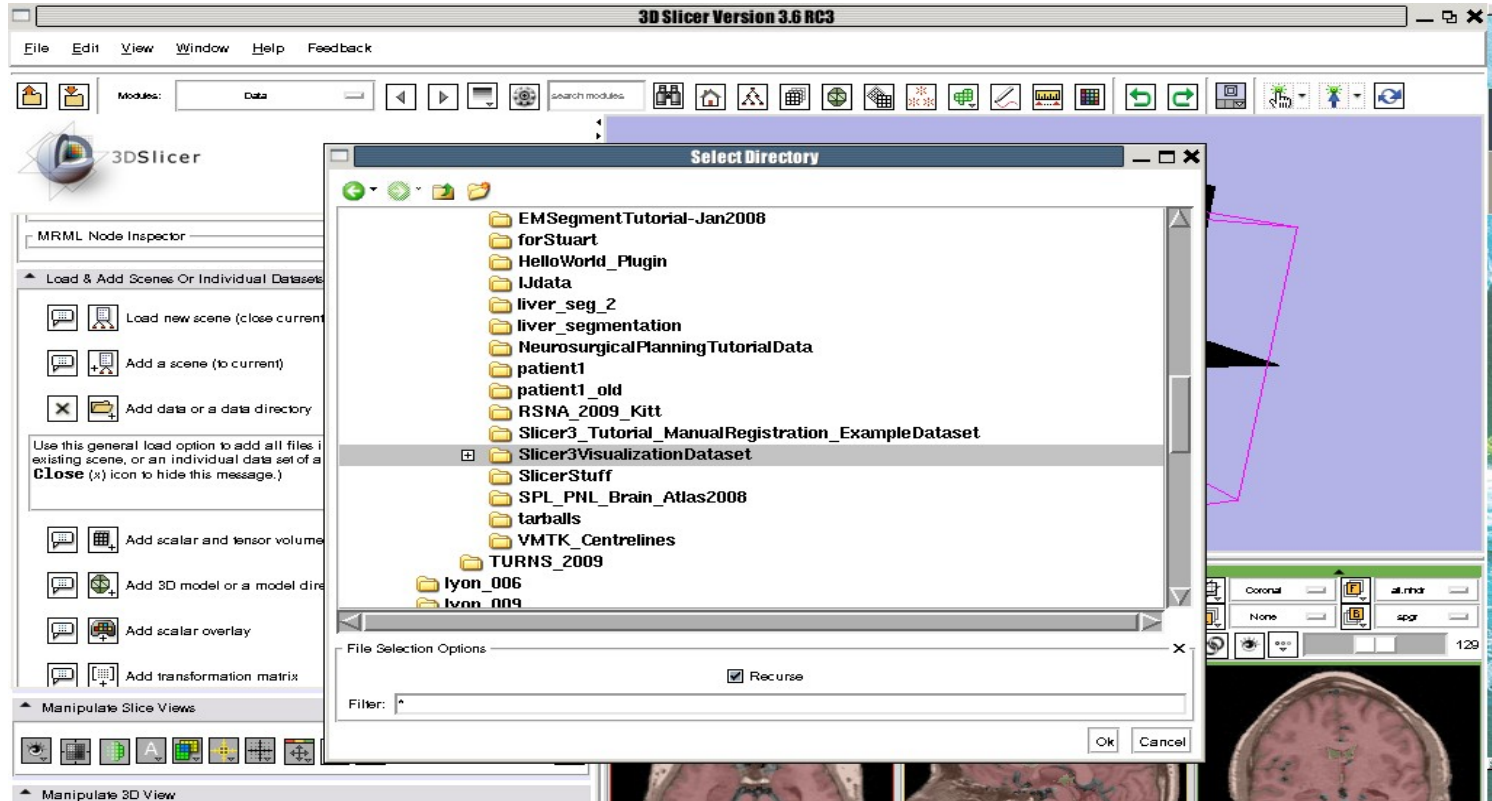


# 3D Visualization



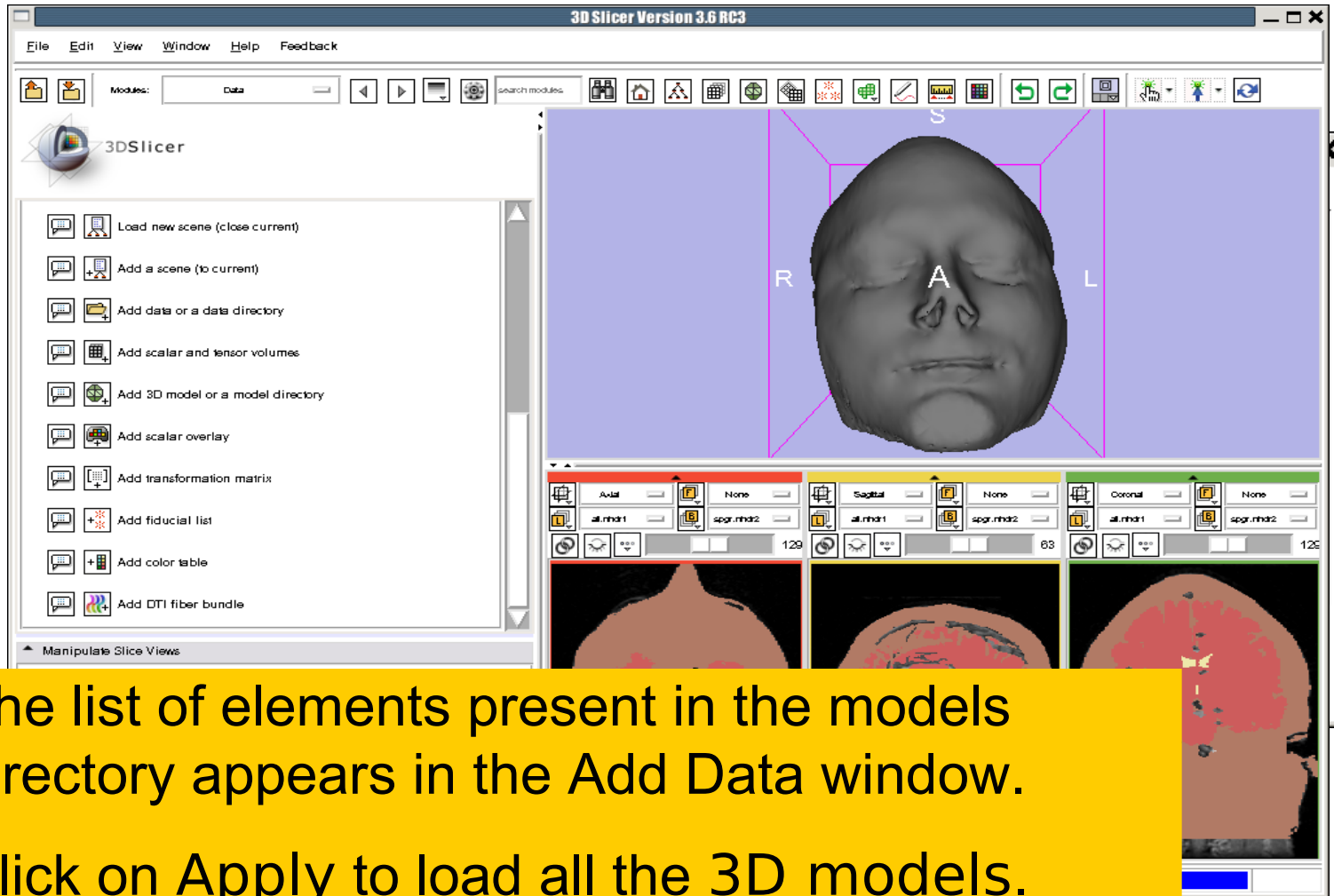


# Loading 3D models



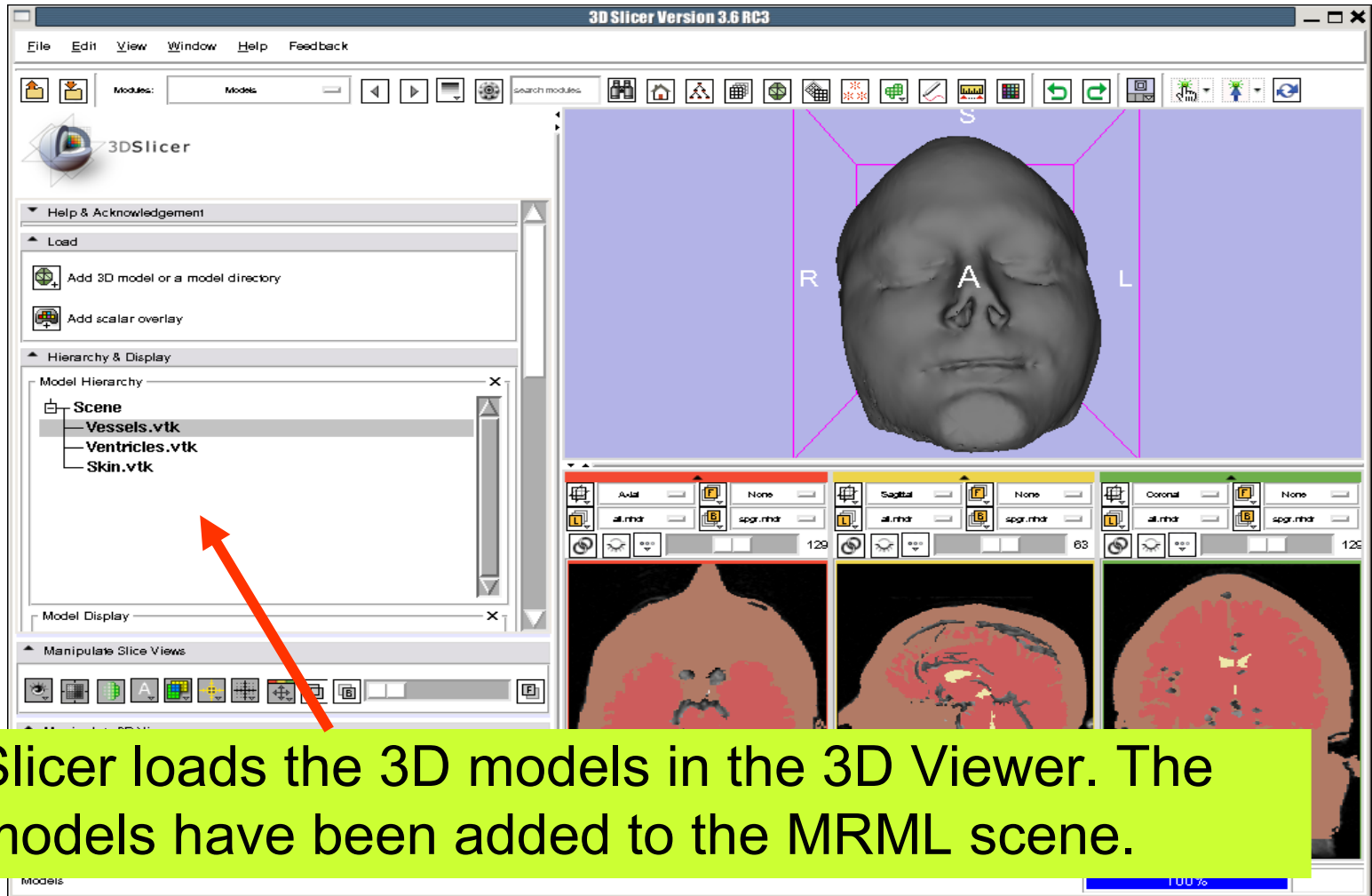
Select the directory  
Slicer3VisualizationDataset/models and click on OK

# Loading 3D models



The list of elements present in the models directory appears in the Add Data window. Click on Apply to load all the 3D models.

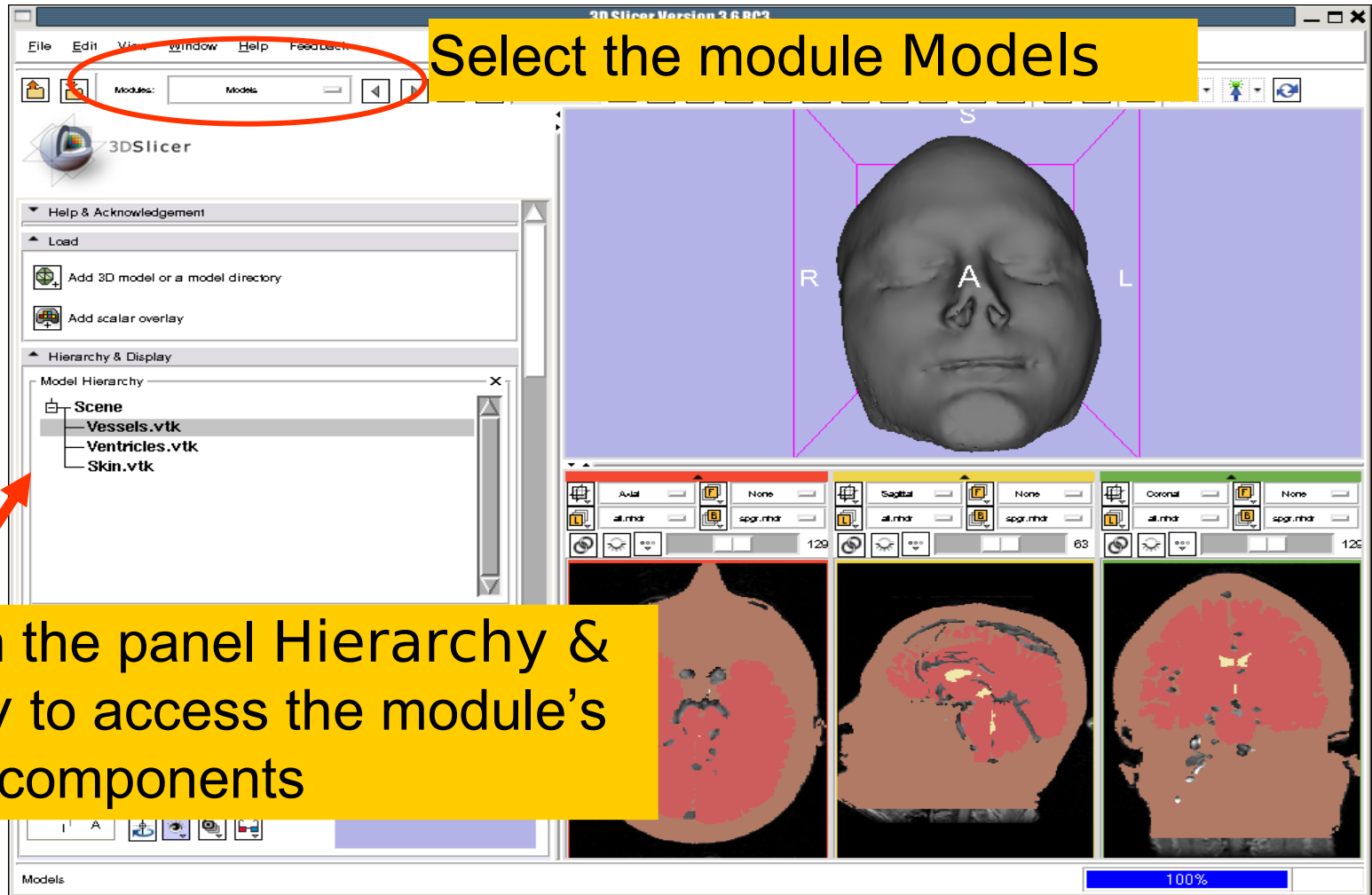
# Loading 3D models



Slicer loads the 3D models in the 3D Viewer. The models have been added to the MRML scene.

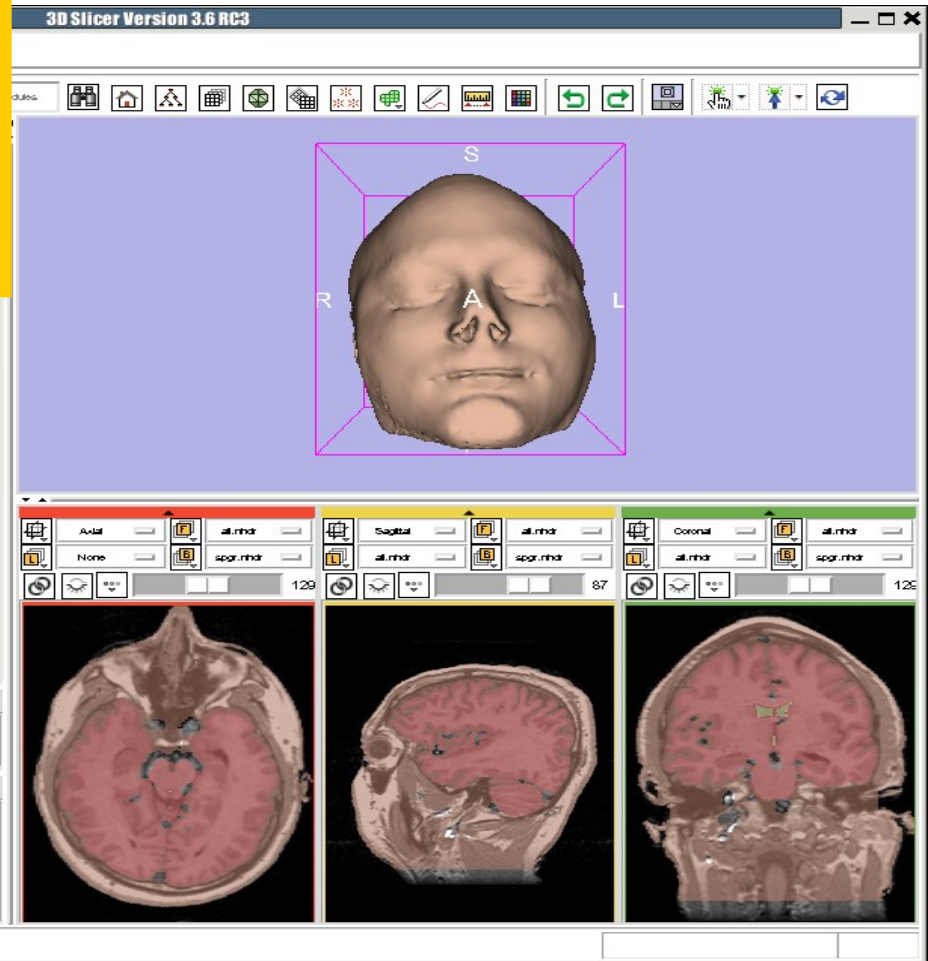
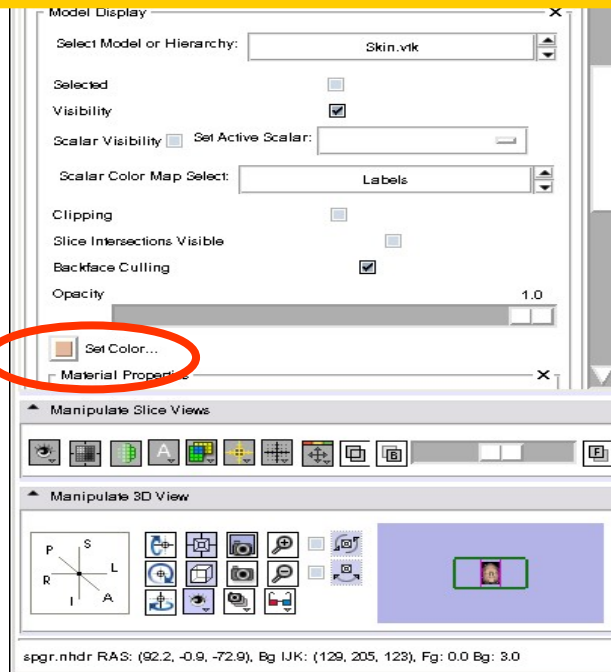


# Loading 3D models

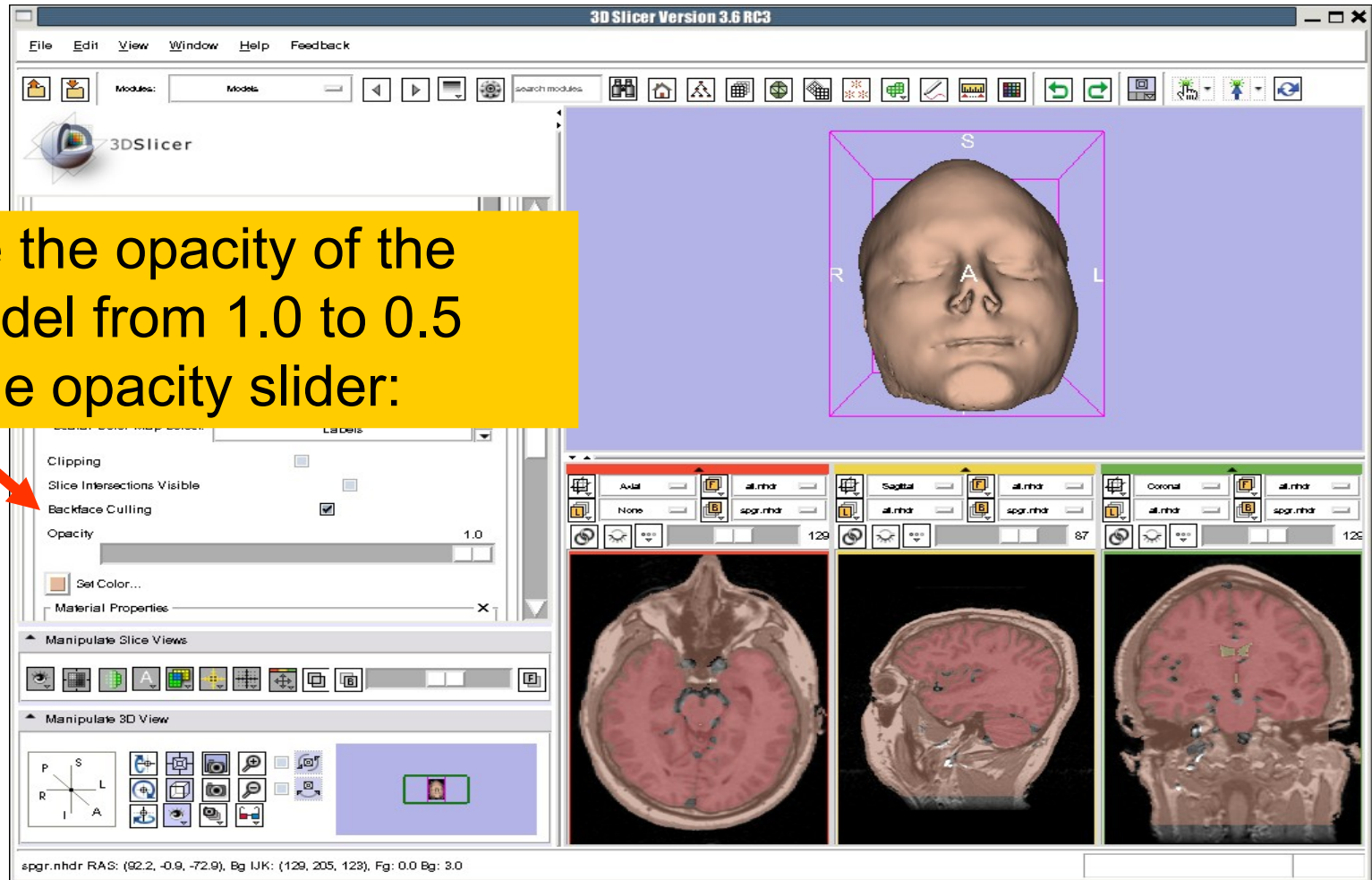


# Visualizing a 3D model

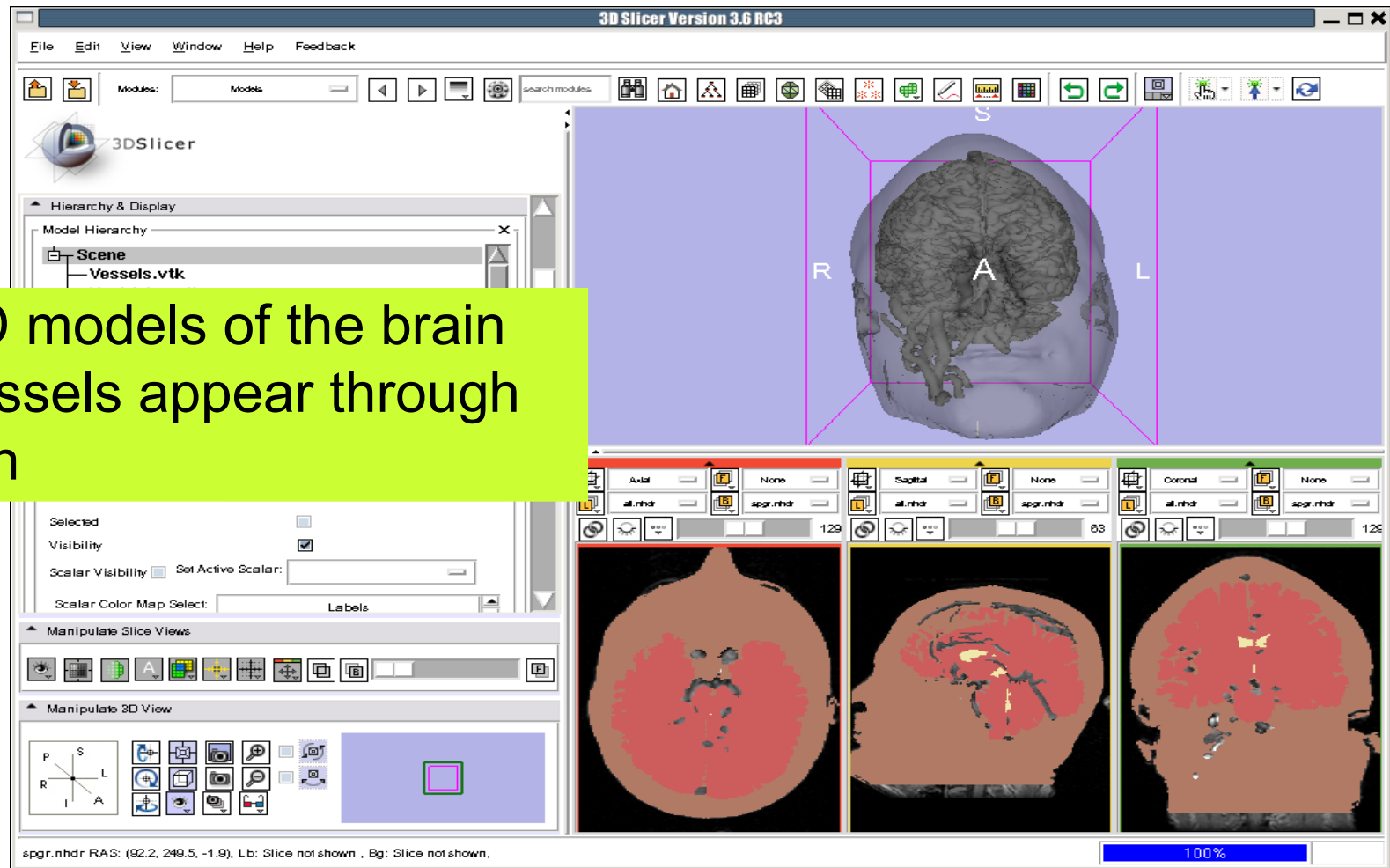
Select the model Skin.vtk  
Click on the icon Set Color  
and choose a new color for  
the 3D model of the head.



# Visualizing a 3D model

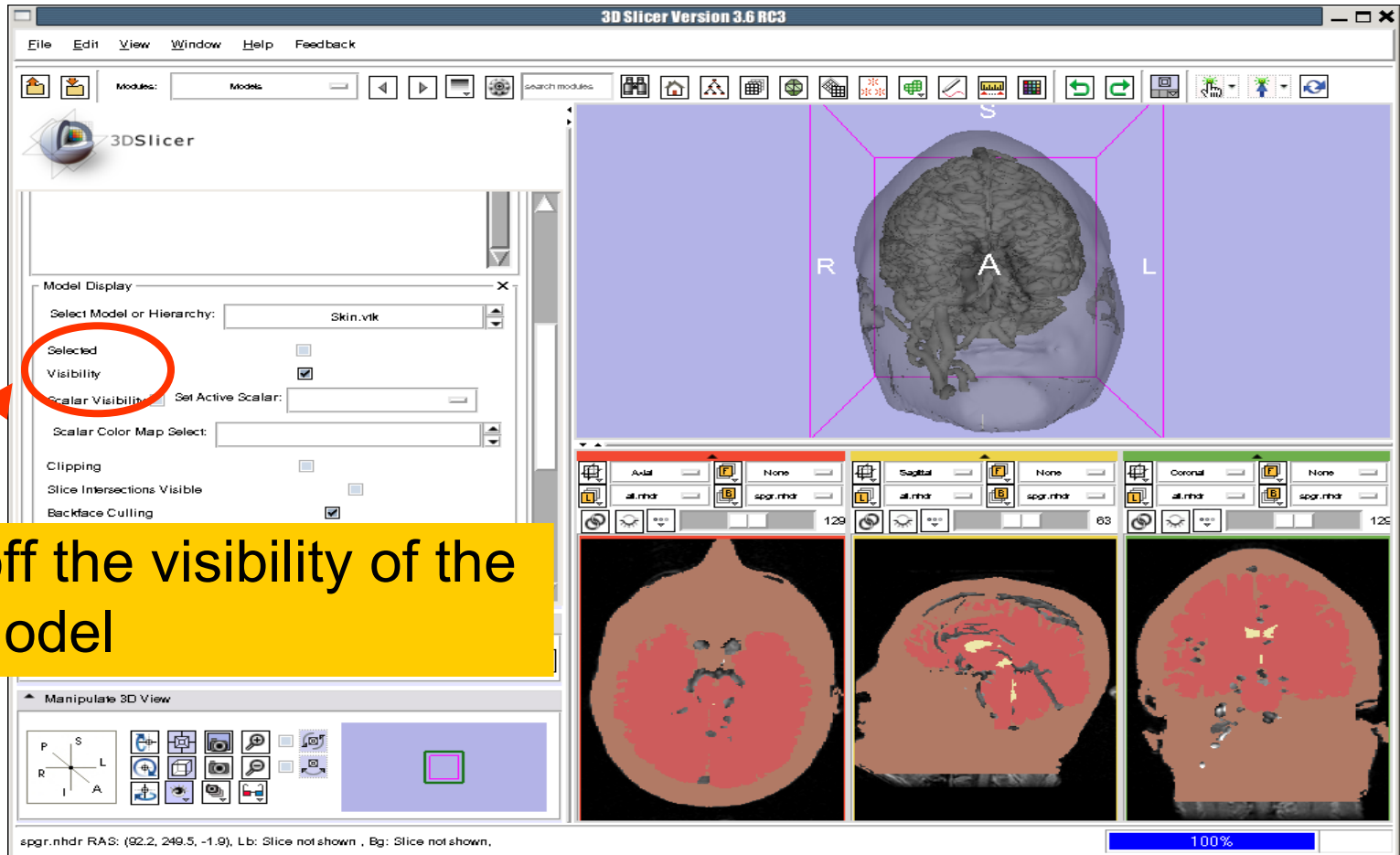


# Visualizing a 3D model

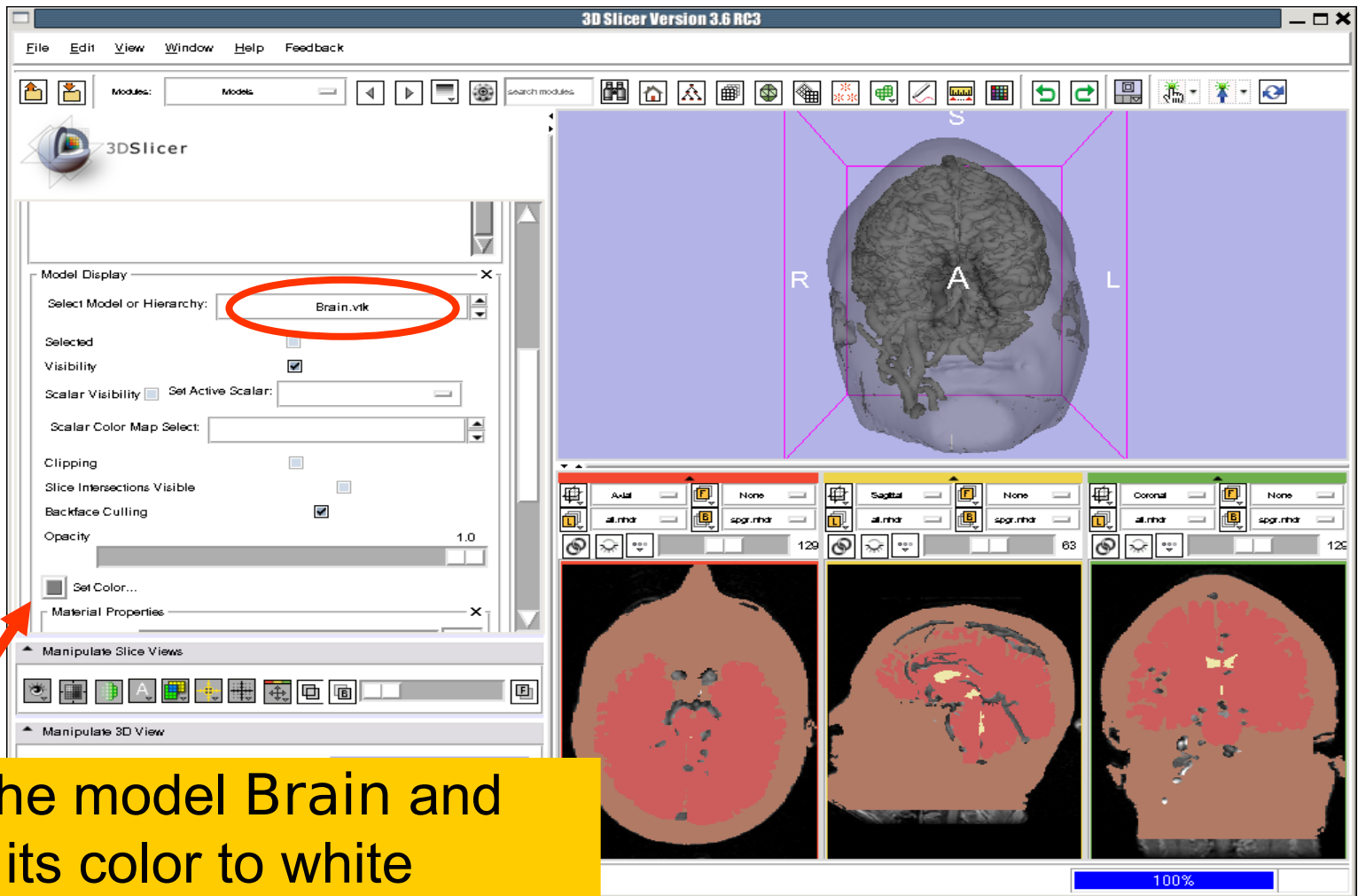


The 3D models of the brain and vessels appear through the skin

# Visualizing a 3D model

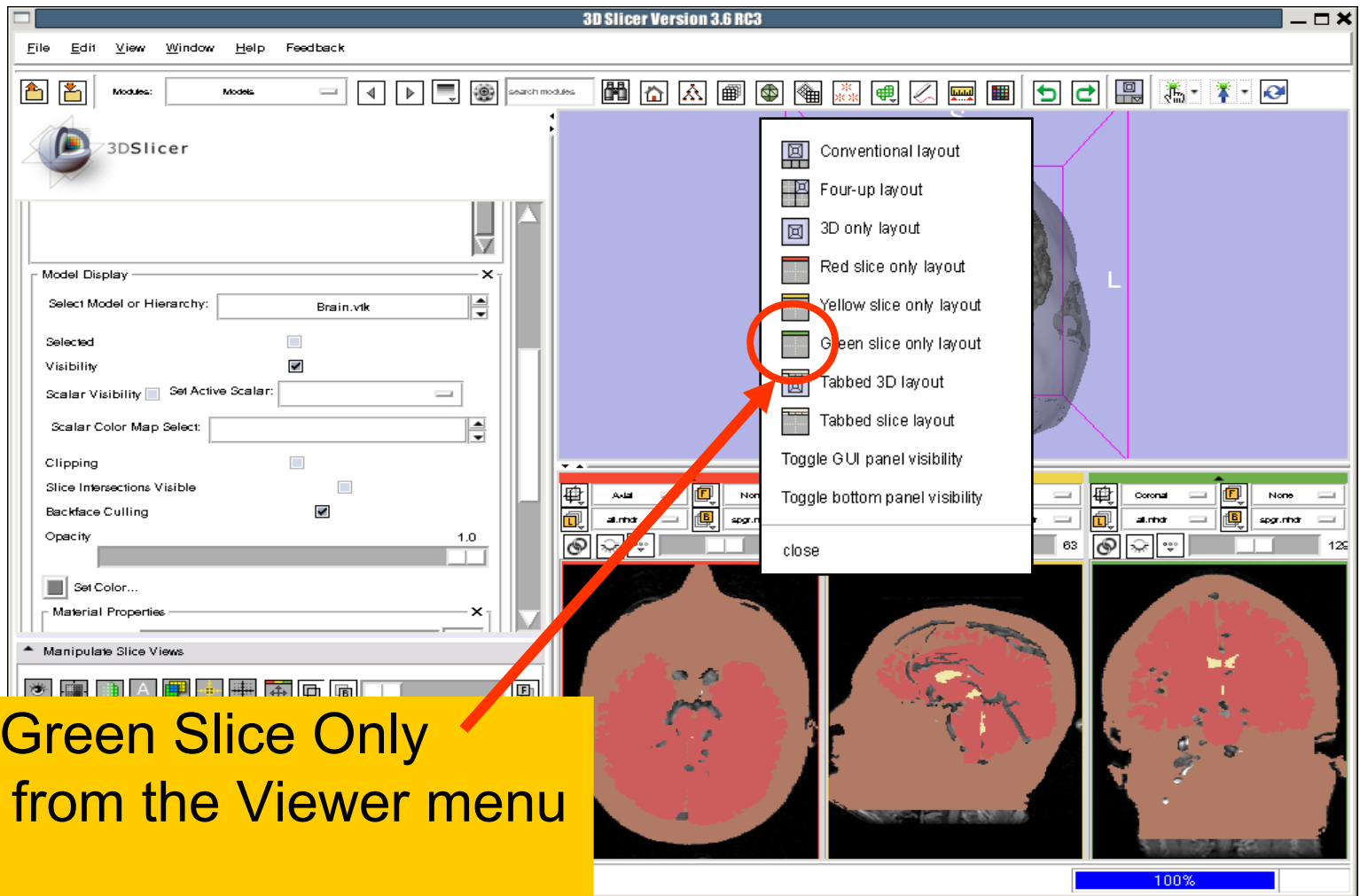


# Visualizing a 3D model



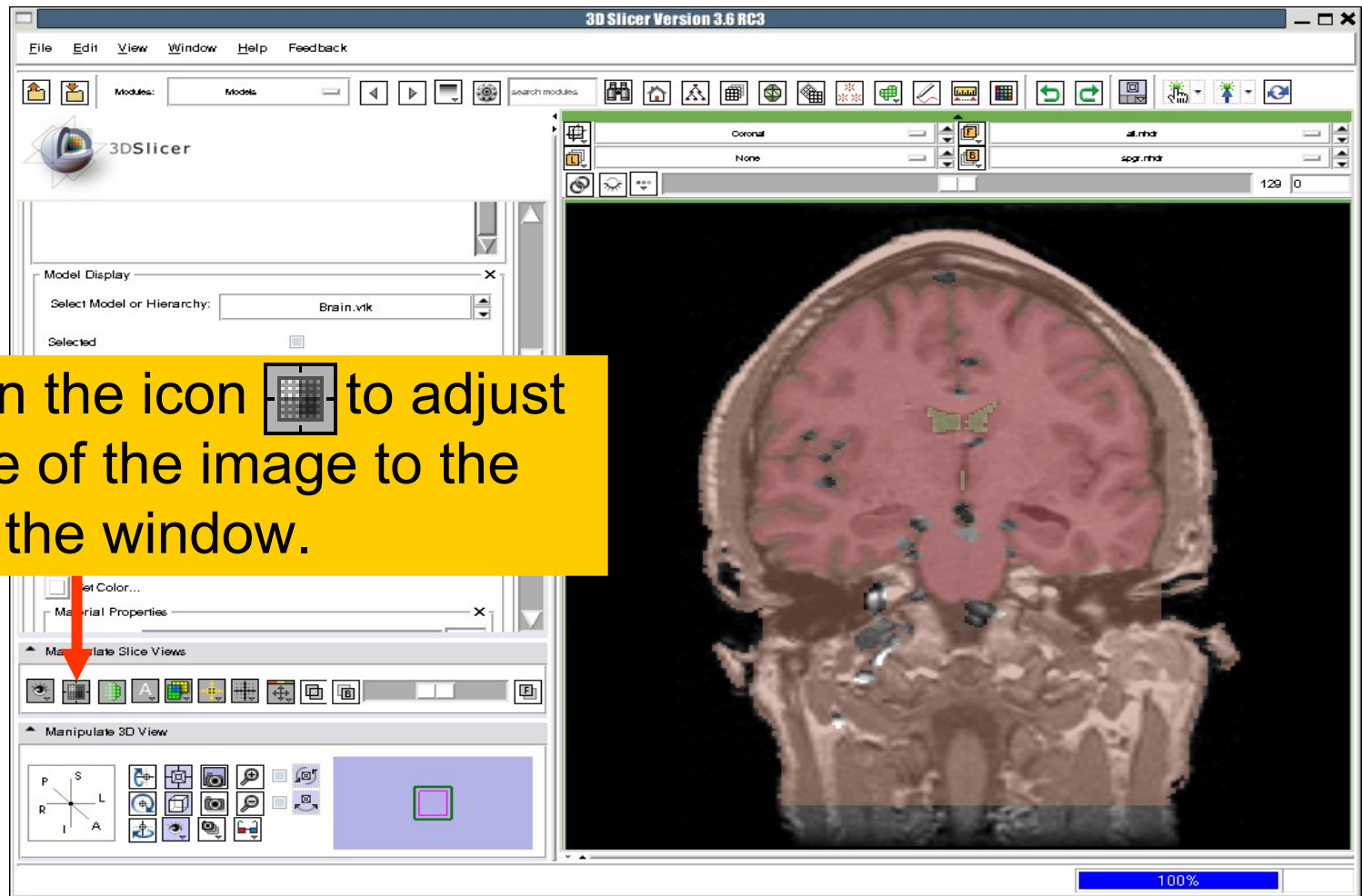


# Visualizing a 3D model

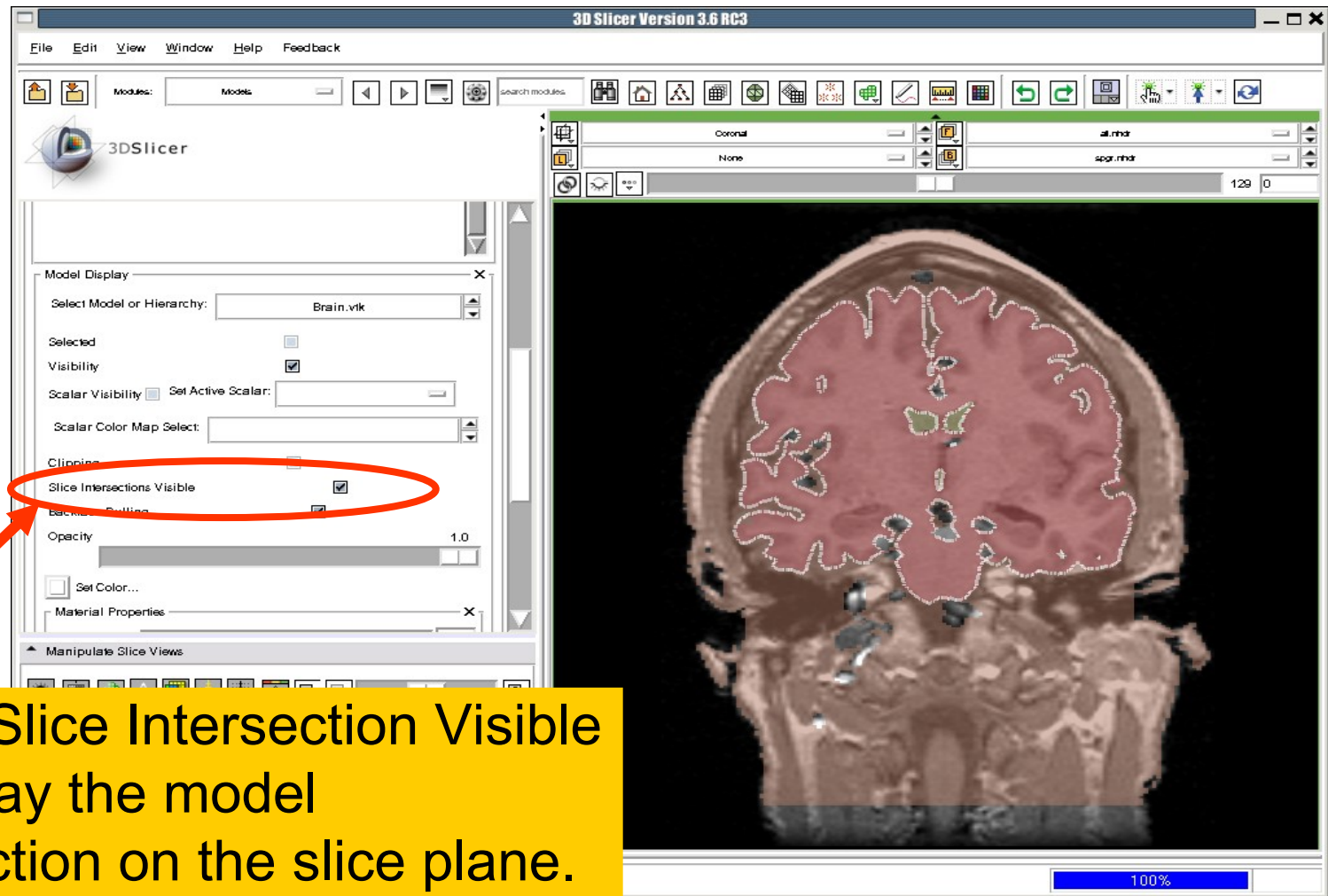


Select Green Slice Only Layout from the Viewer menu

# Visualizing a 3D model

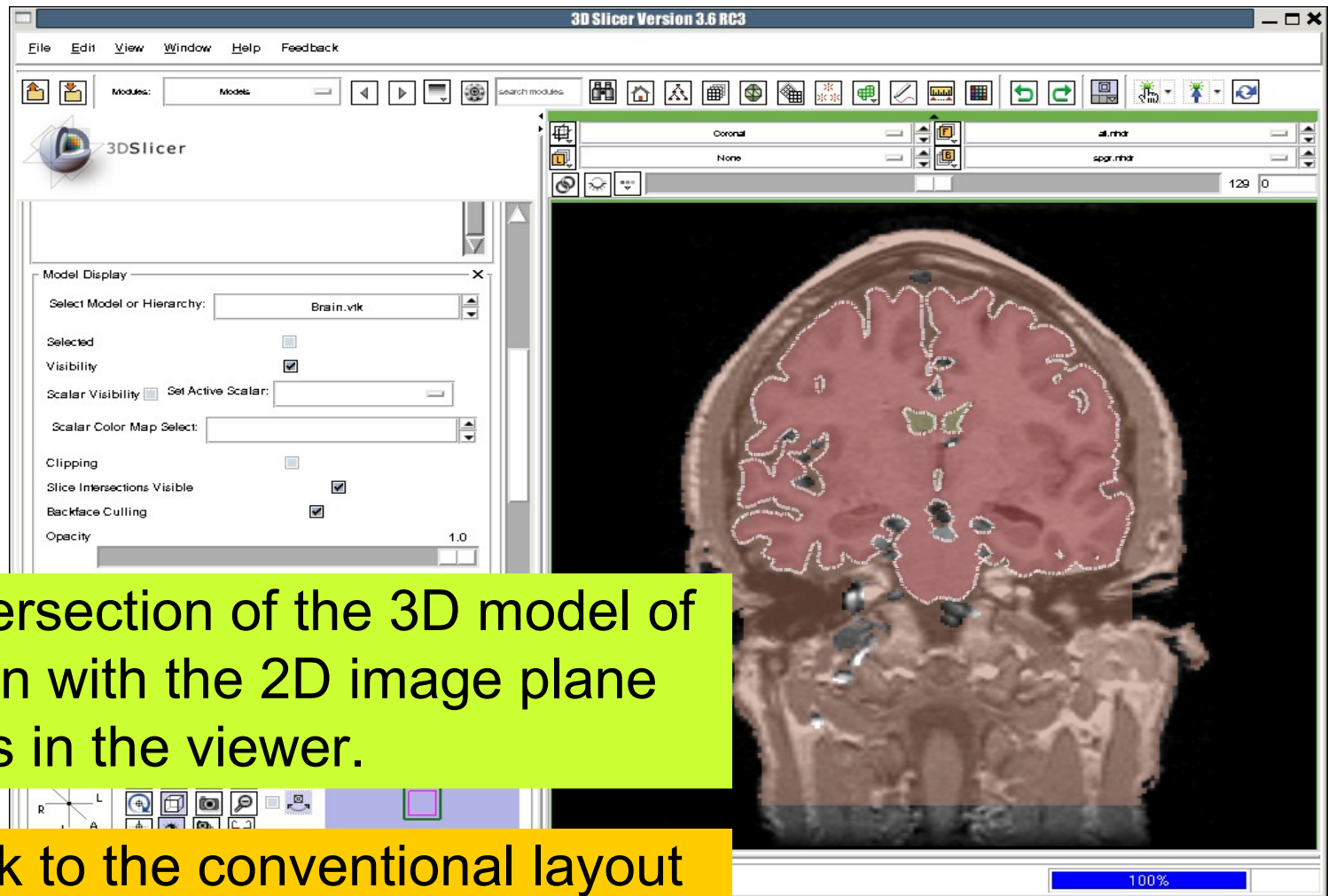


# Visualizing a 3D model



Select Slice Intersection Visible to display the model intersection on the slice plane.

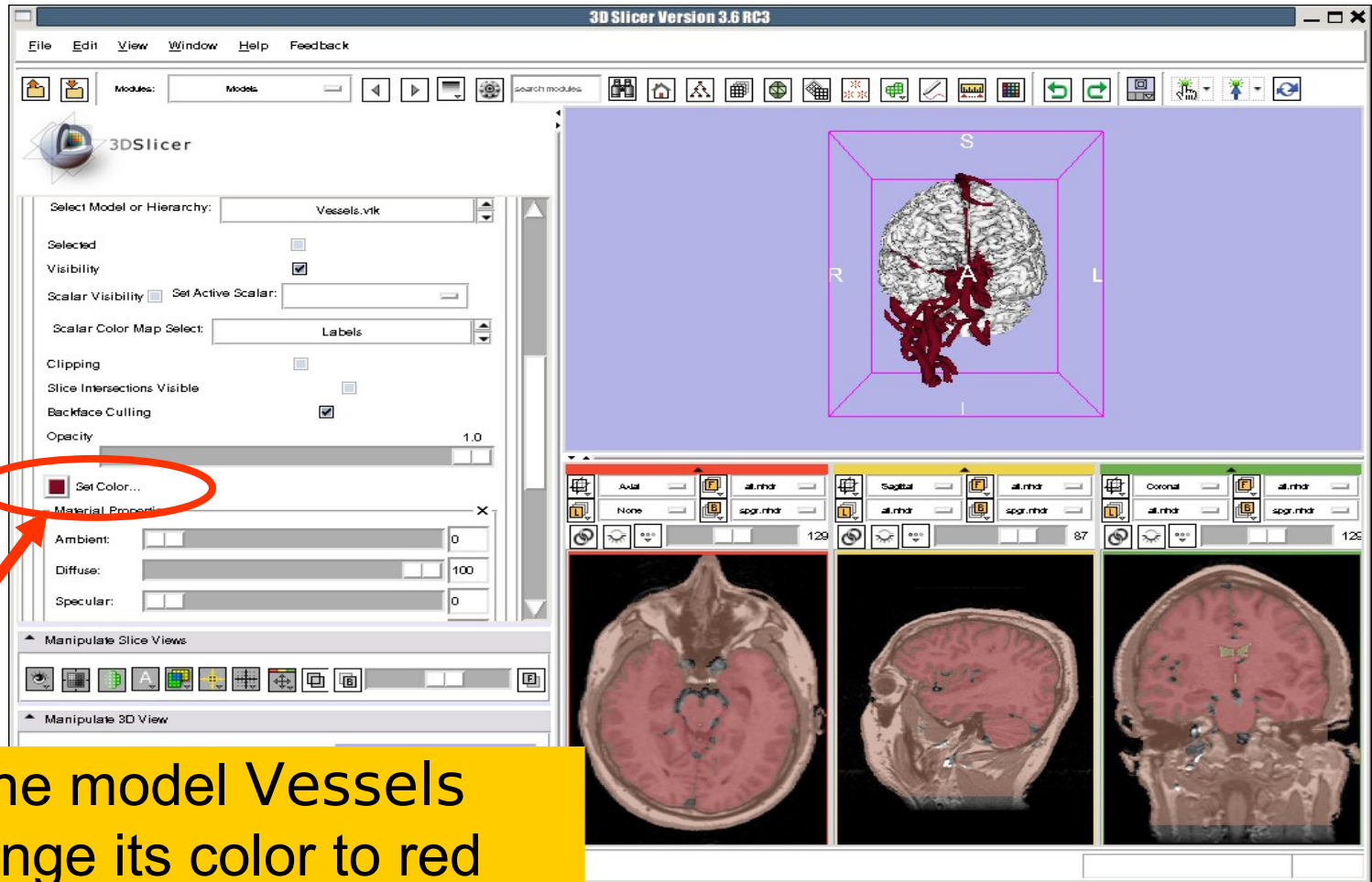
# Visualizing a 3D model



The intersection of the 3D model of the brain with the 2D image plane appears in the viewer.

Go back to the conventional layout

# Visualizing a 3D model

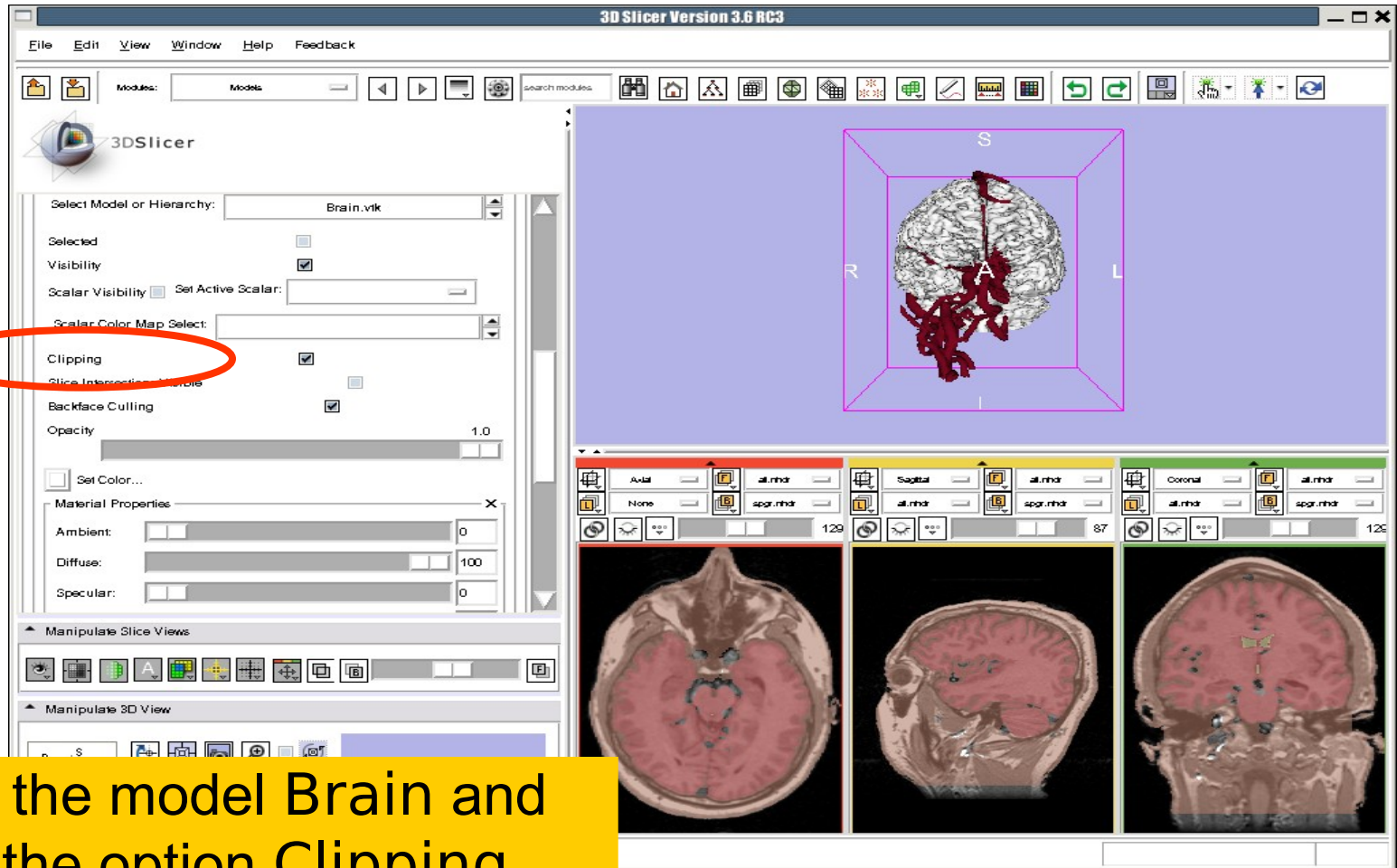


Select the model Vessels and change its color to red





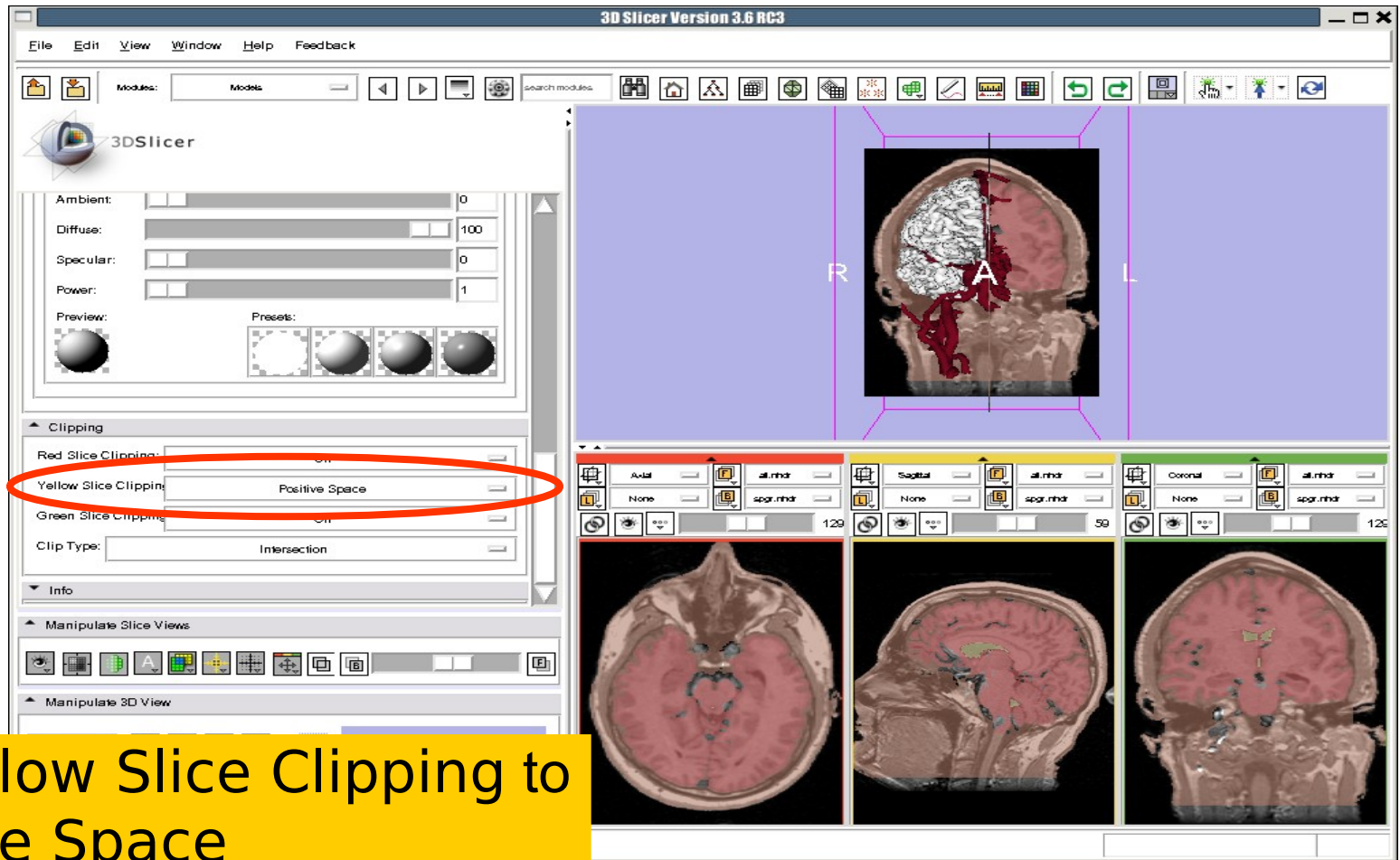
# Visualizing a 3D model



Select the model Brain and select the option Clipping

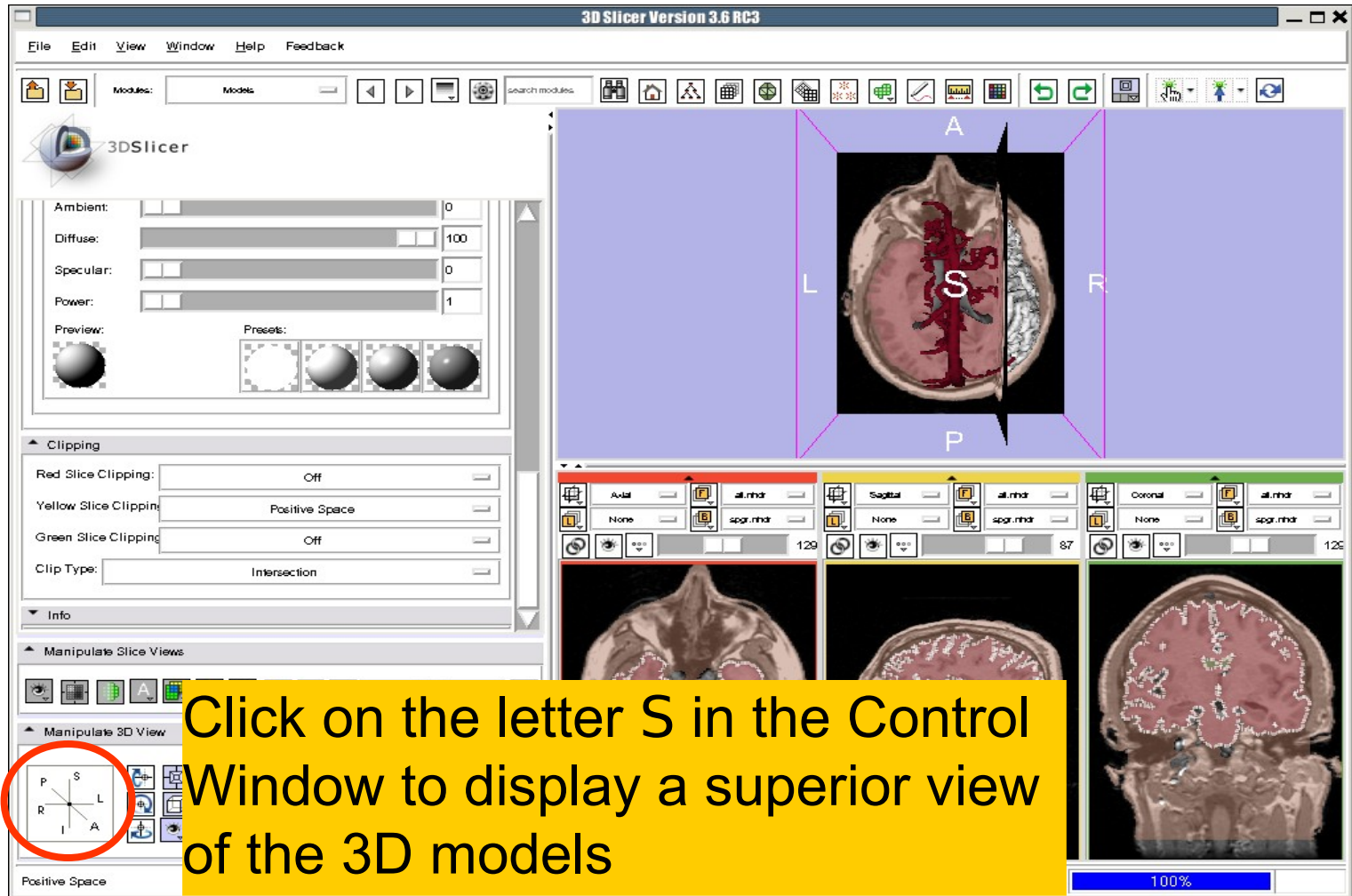


# Visualizing a 3D model

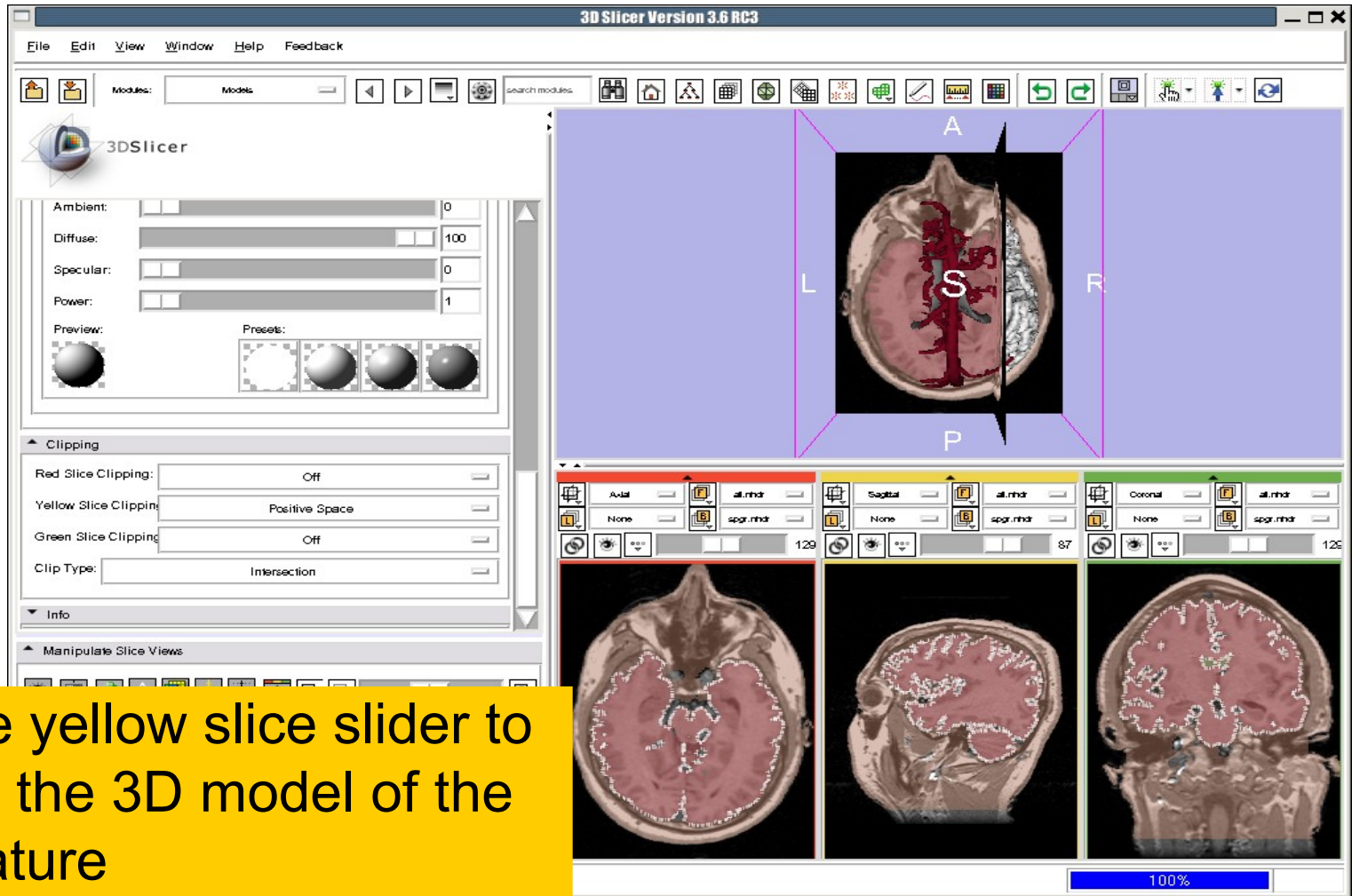


Set Yellow Slice Clipping to Positive Space

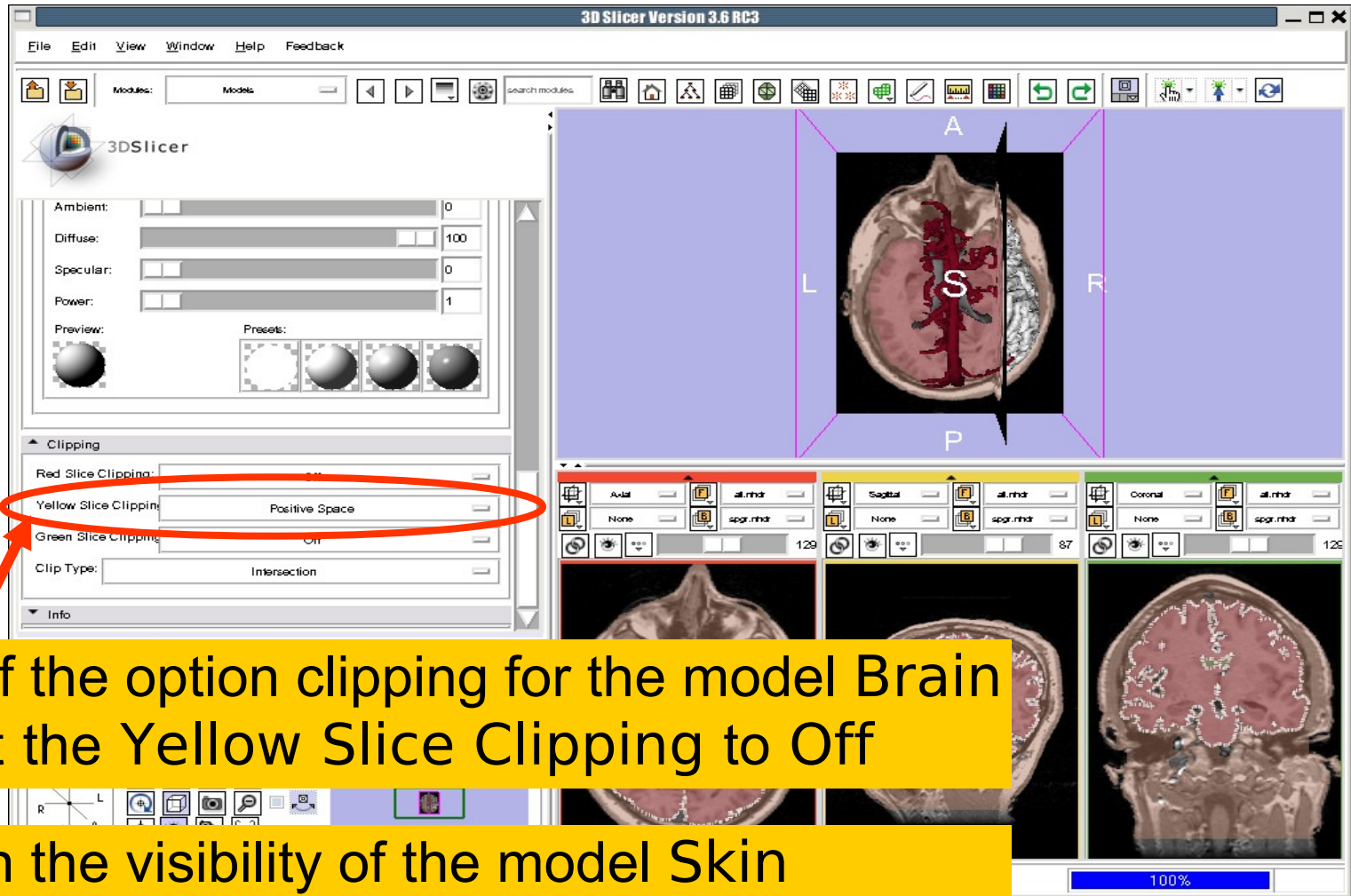
# Visualizing a 3D model



# Visualizing a 3D model

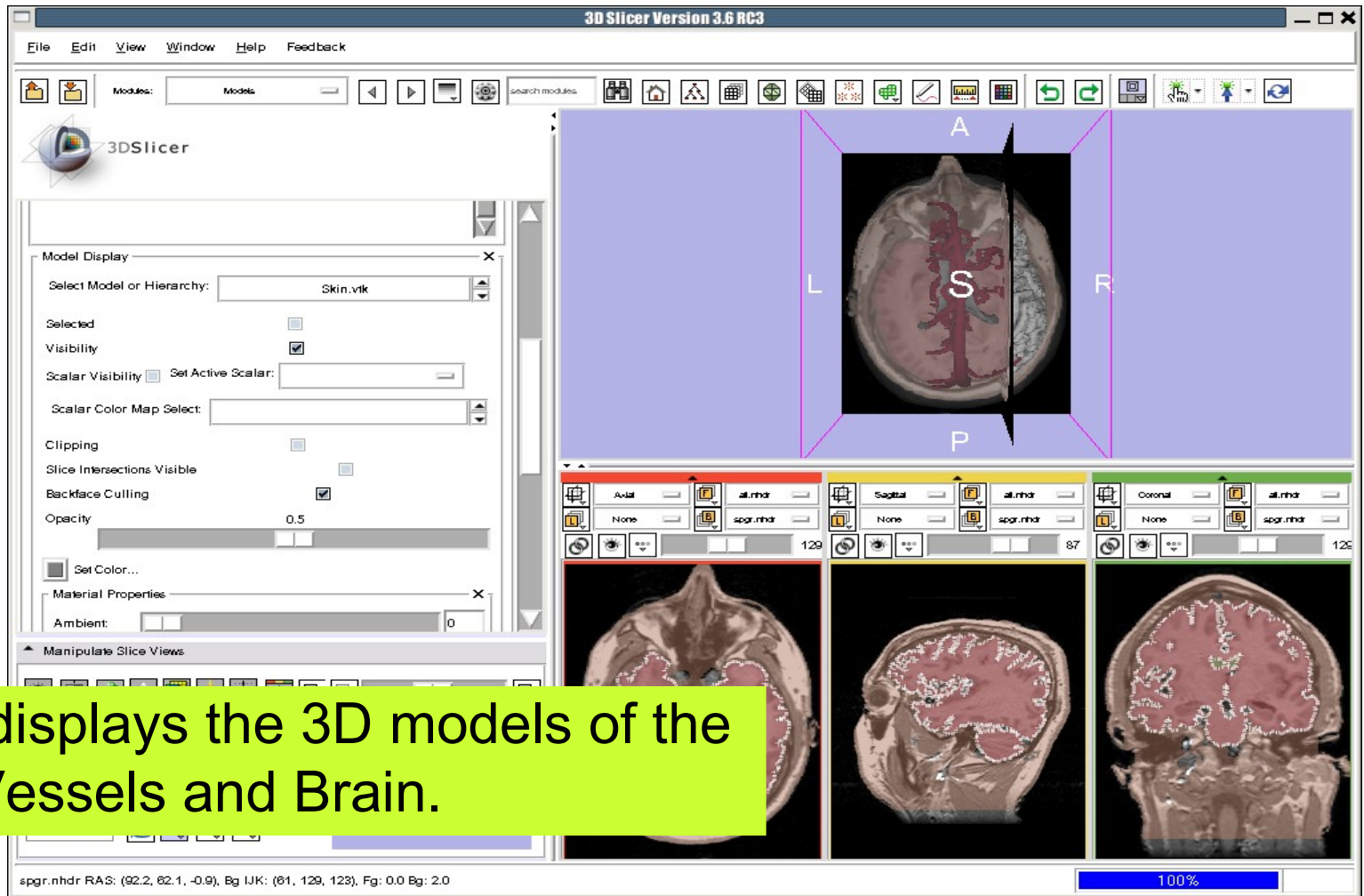


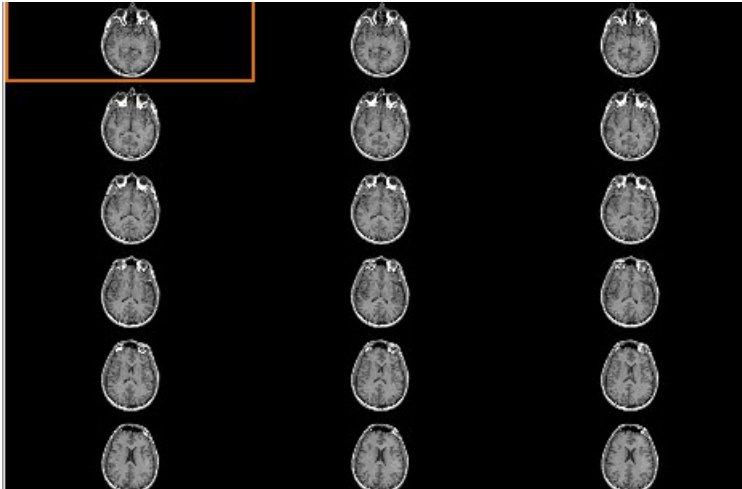
# Visualizing a 3D model





# Visualizing a 3D model

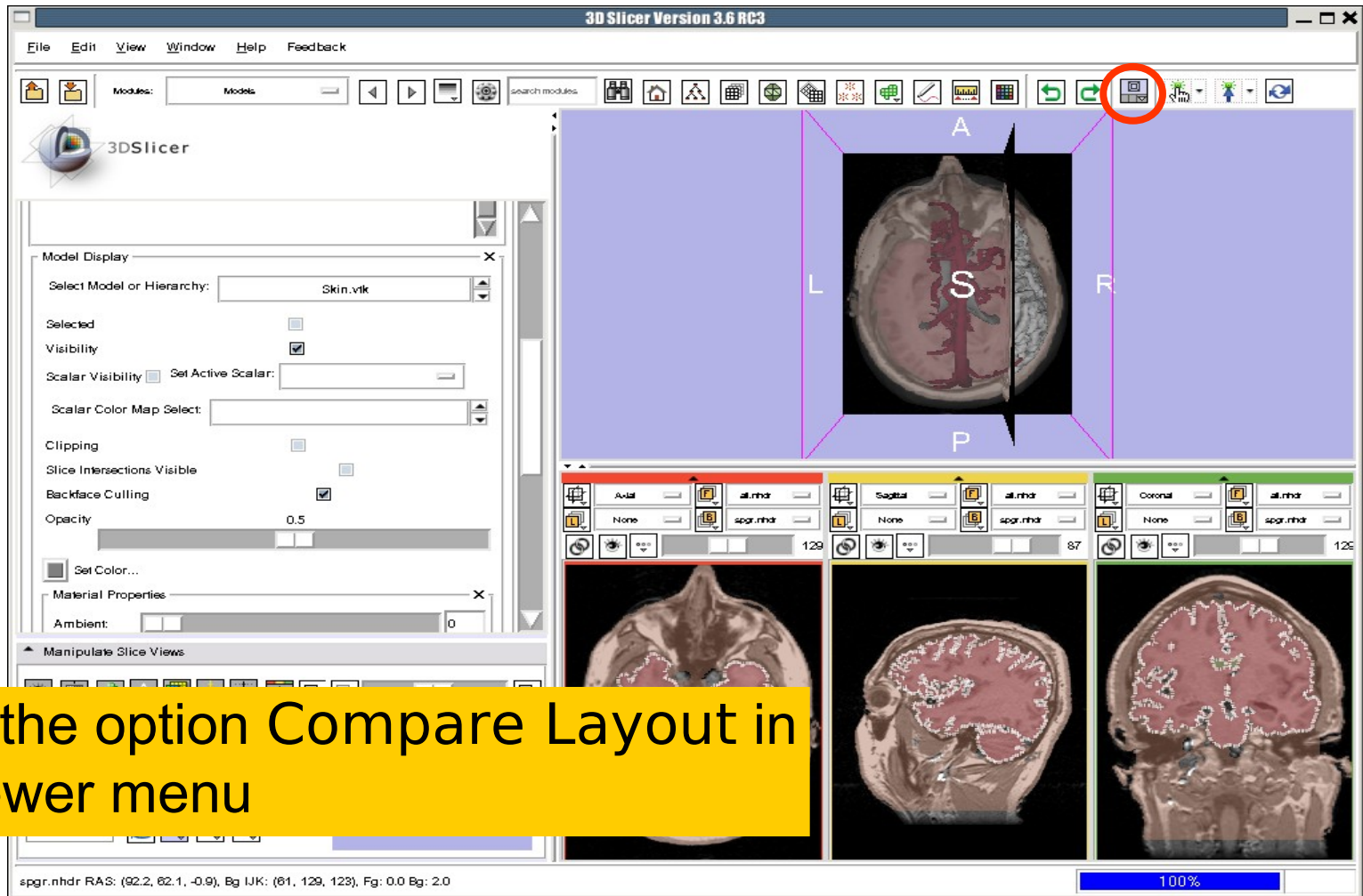




## Part 4: Lightbox viewer

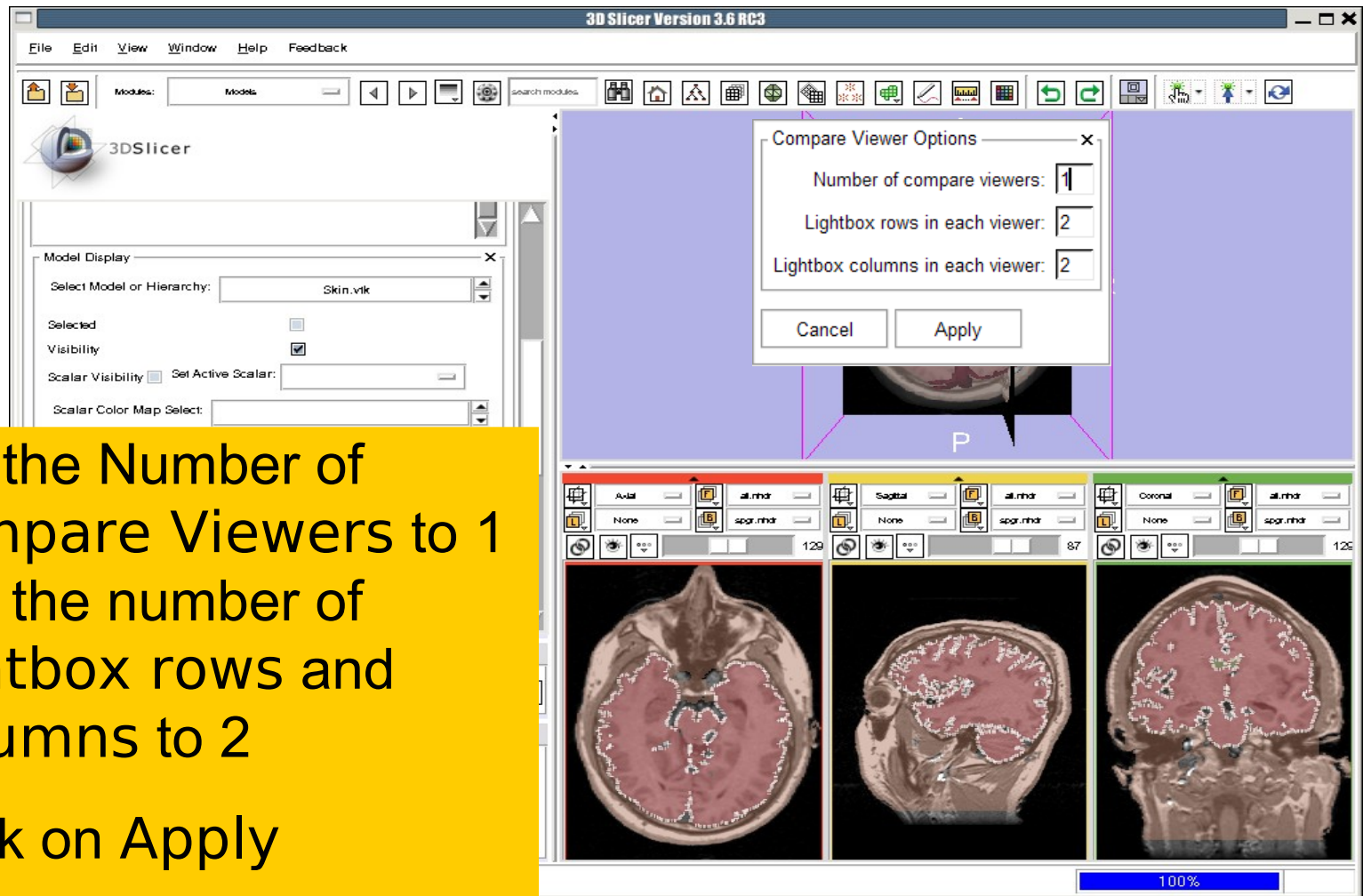


# Visualizing a 3D model

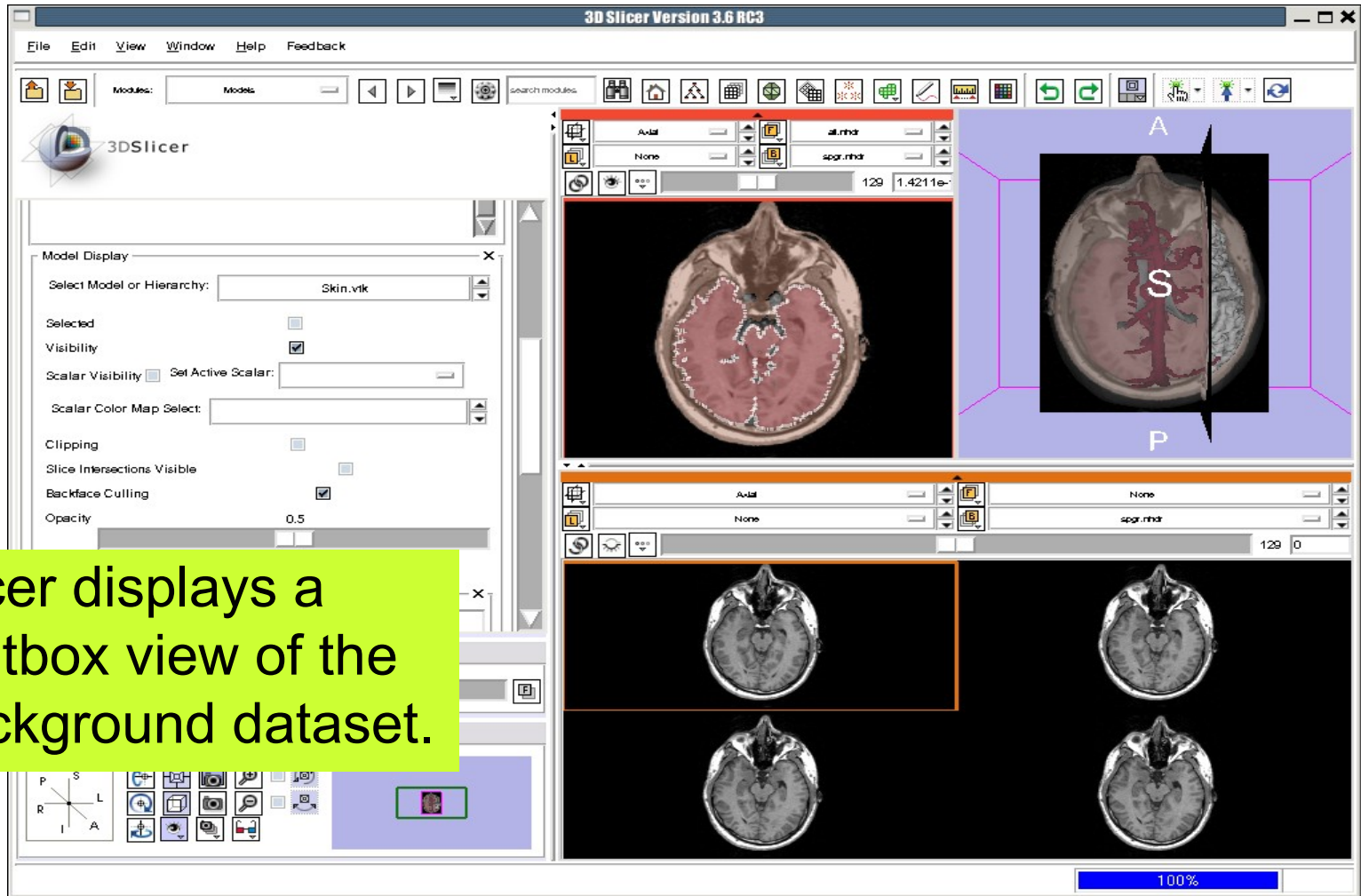


Select the option Compare Layout in the Viewer menu

# Visualizing a 3D model

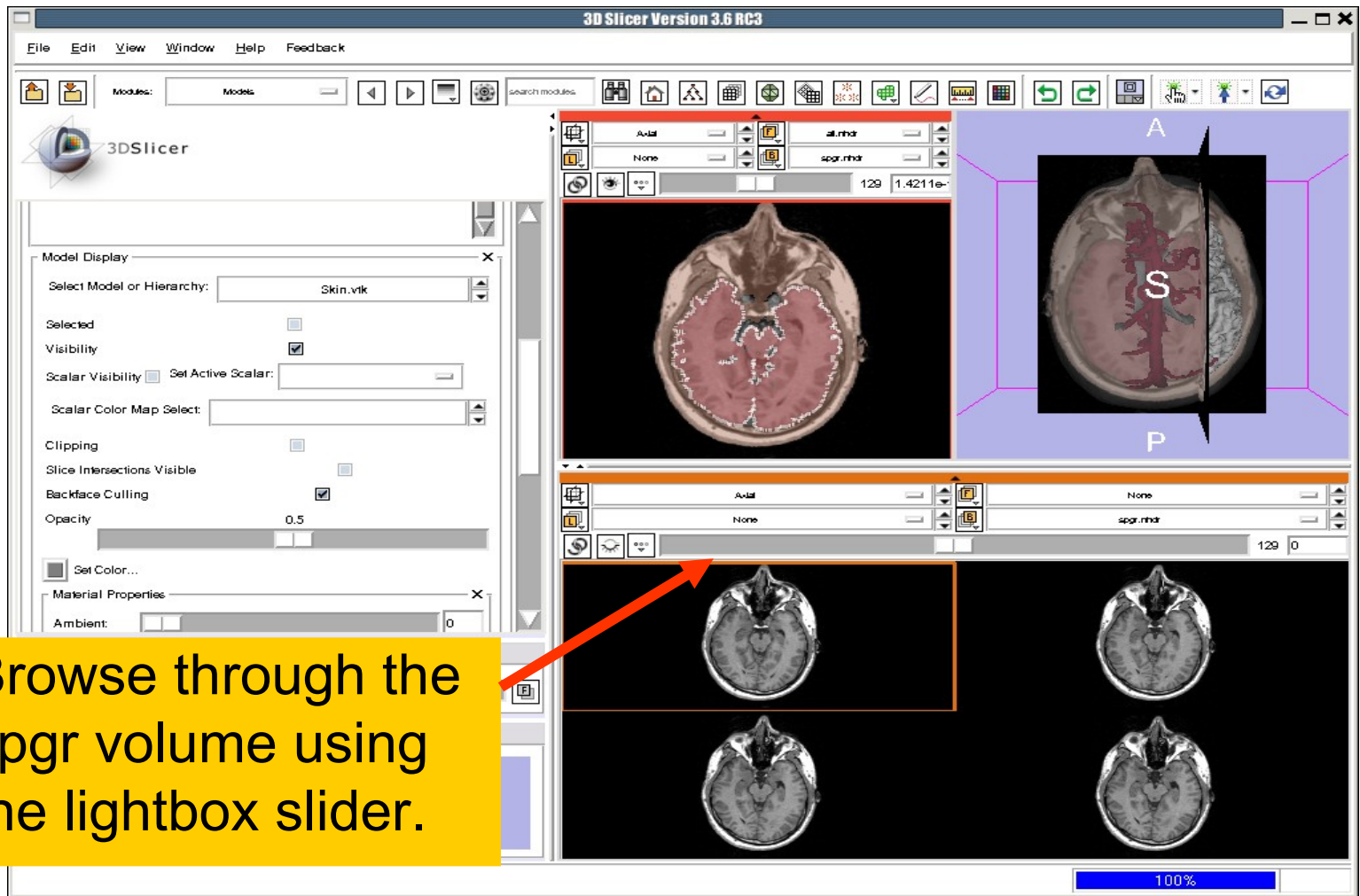


# Lightbox viewer



Slicer displays a lightbox view of the Background dataset.

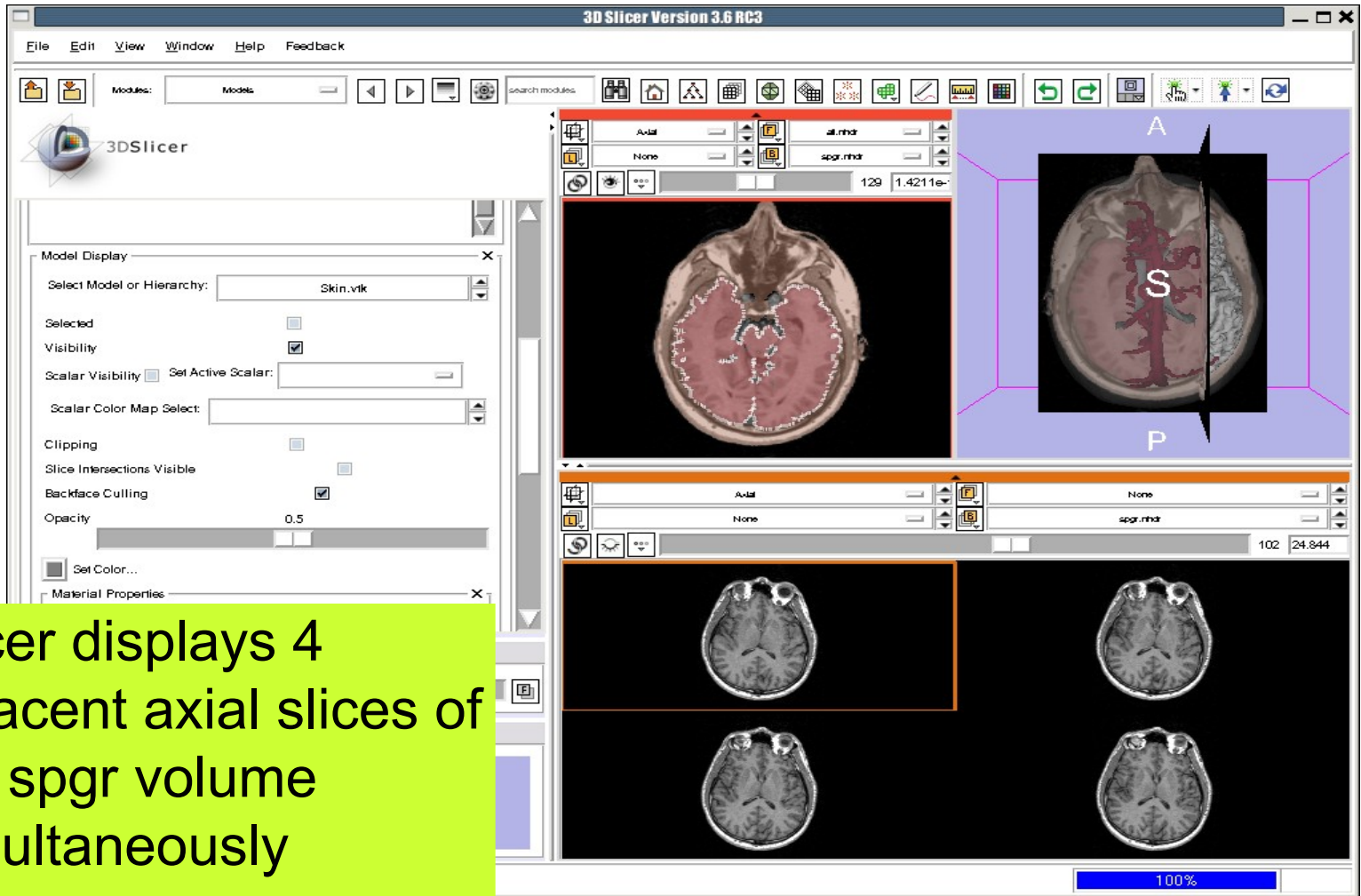
# Lightbox viewer



Browse through the  
spgr volume using  
the lightbox slider.

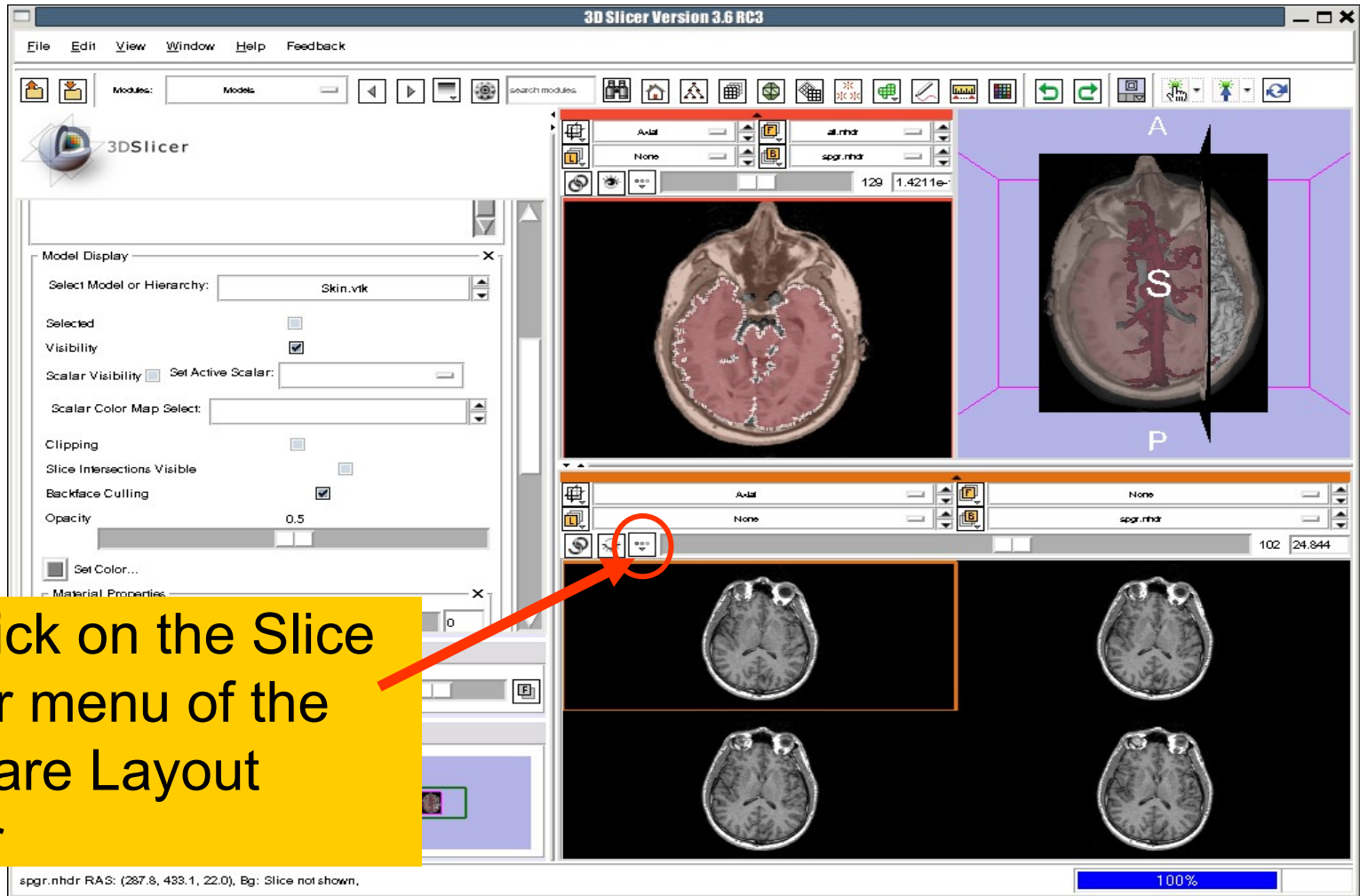
# Lightbox viewer

Slicer displays 4 adjacent axial slices of the spgr volume simultaneously



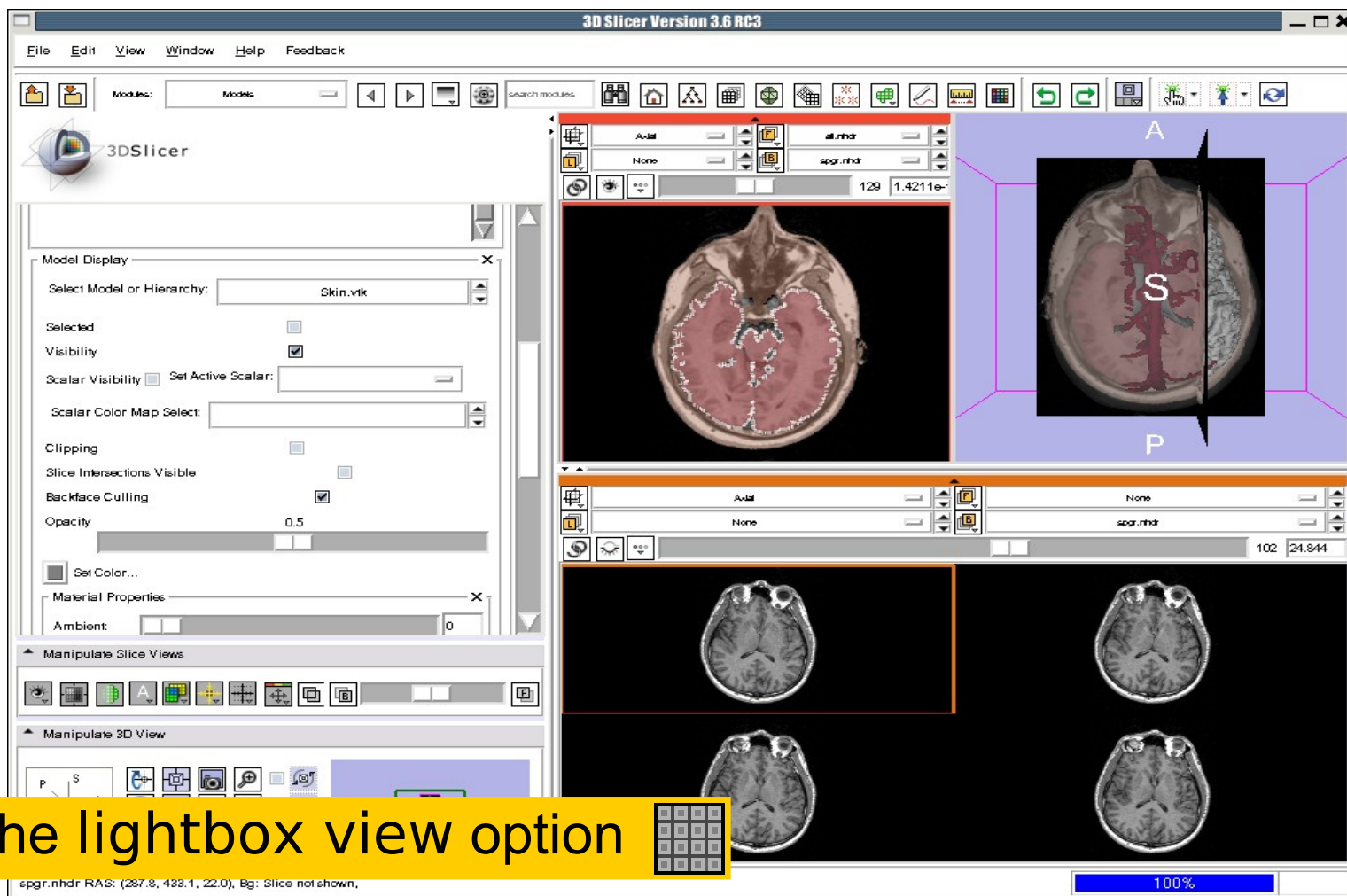


# Lightbox viewer

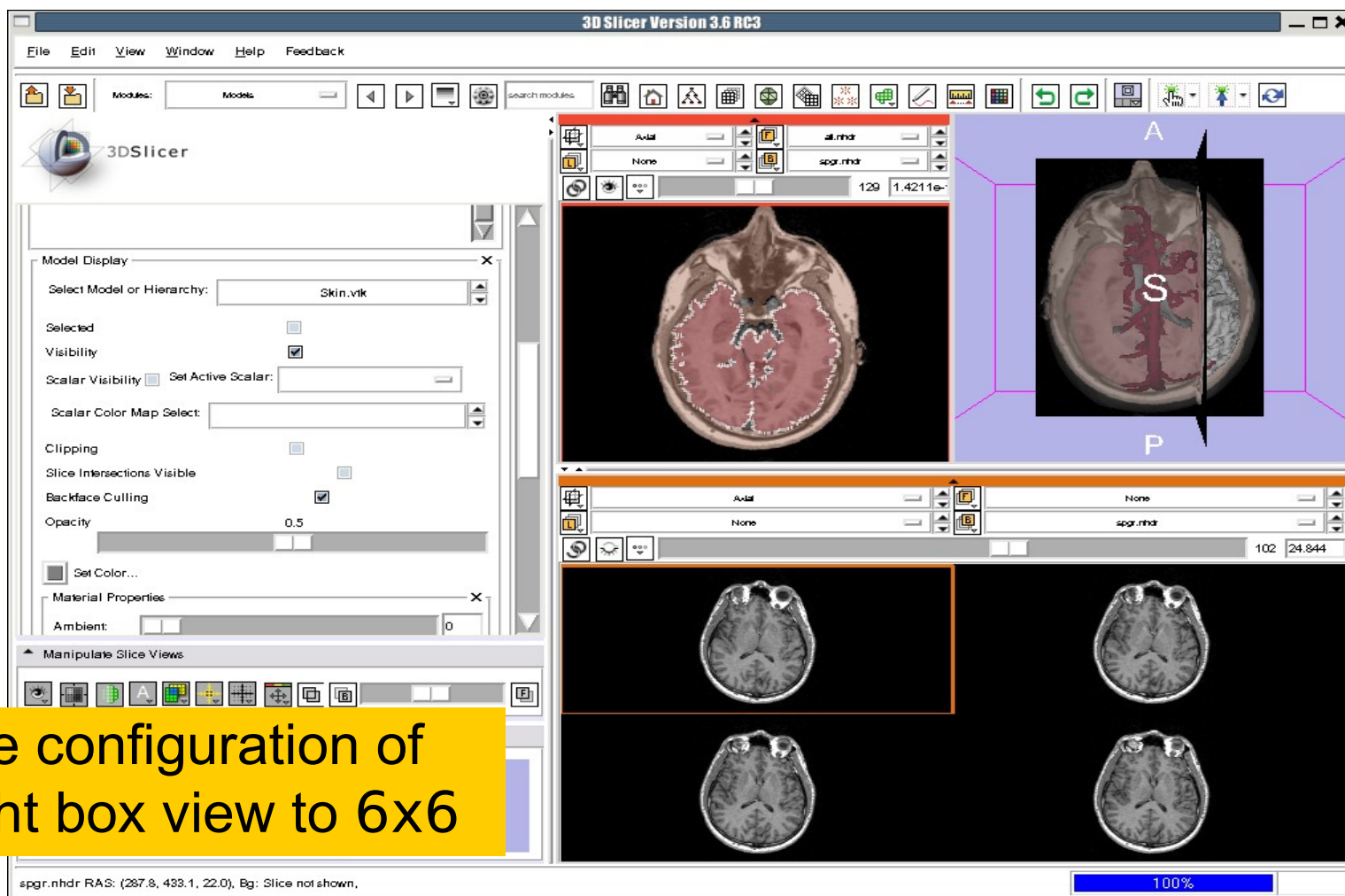




# Lightbox viewer



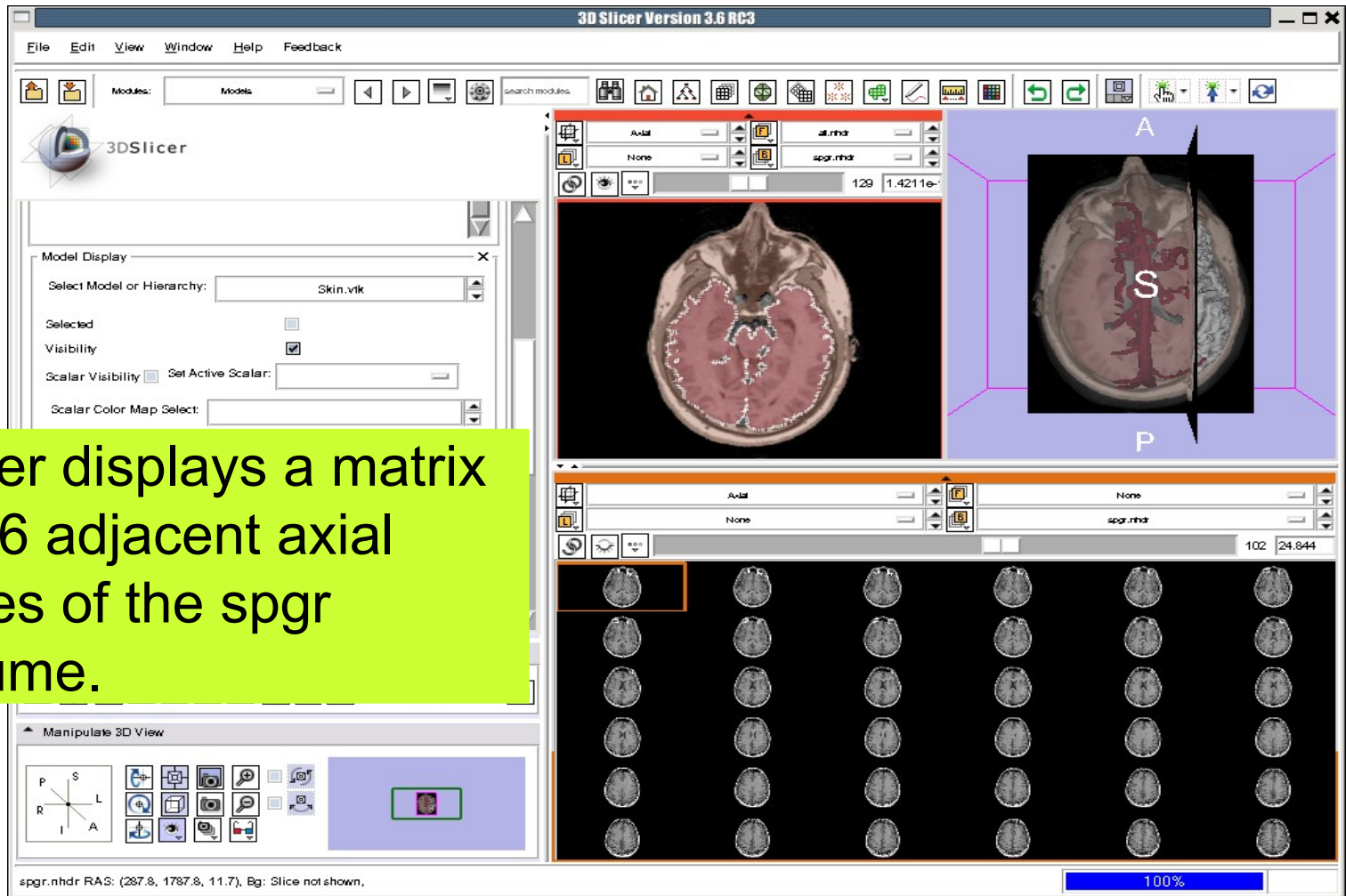
# Lightbox viewer



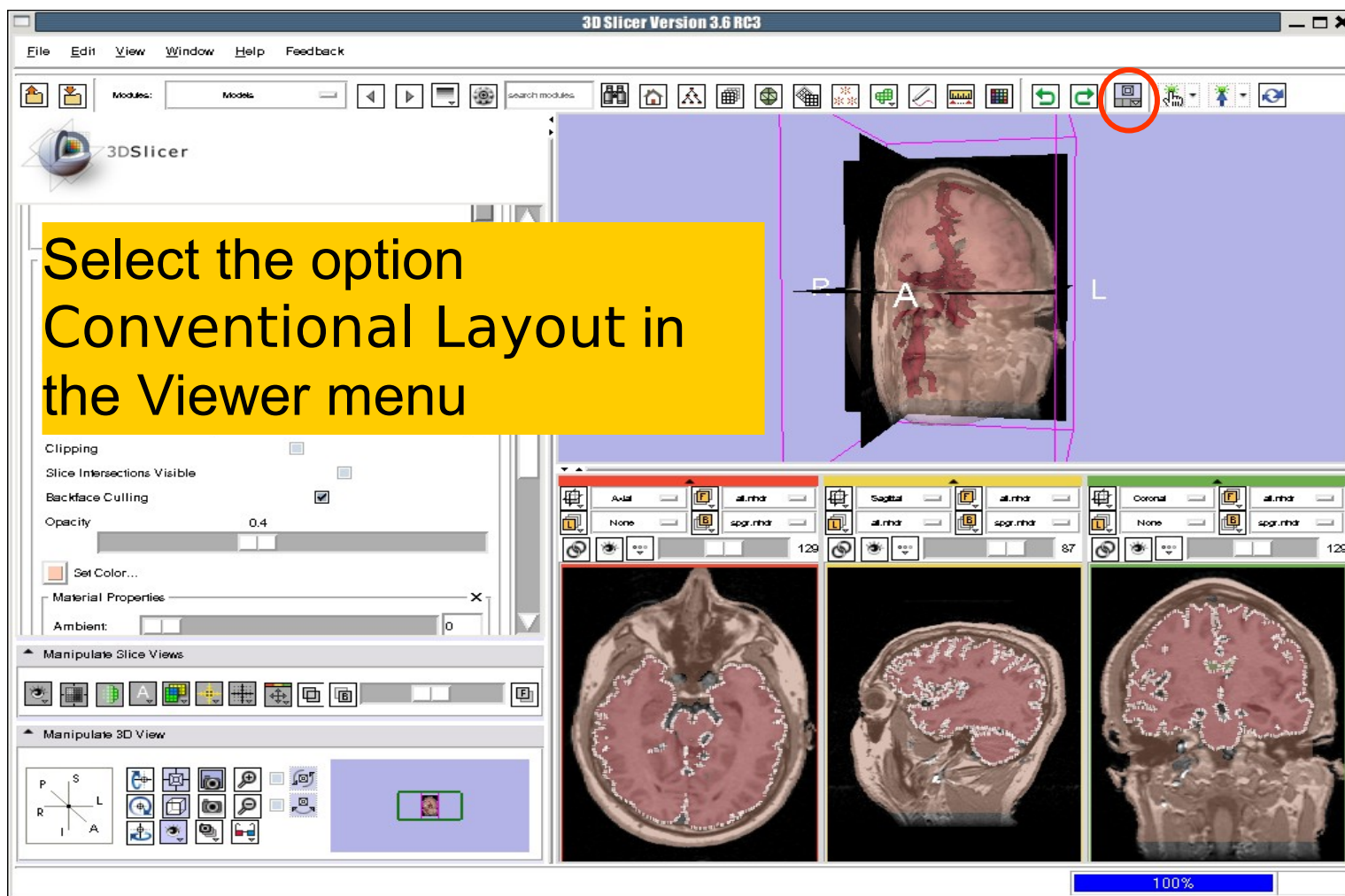
Set the configuration of the light box view to 6x6

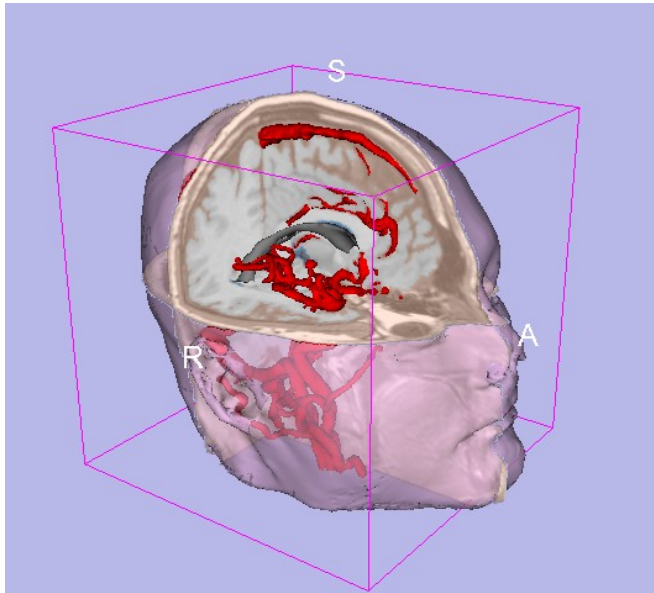
# Lightbox viewer

Slicer displays a matrix of 36 adjacent axial slices of the spgr volume.



# Lightbox viewer

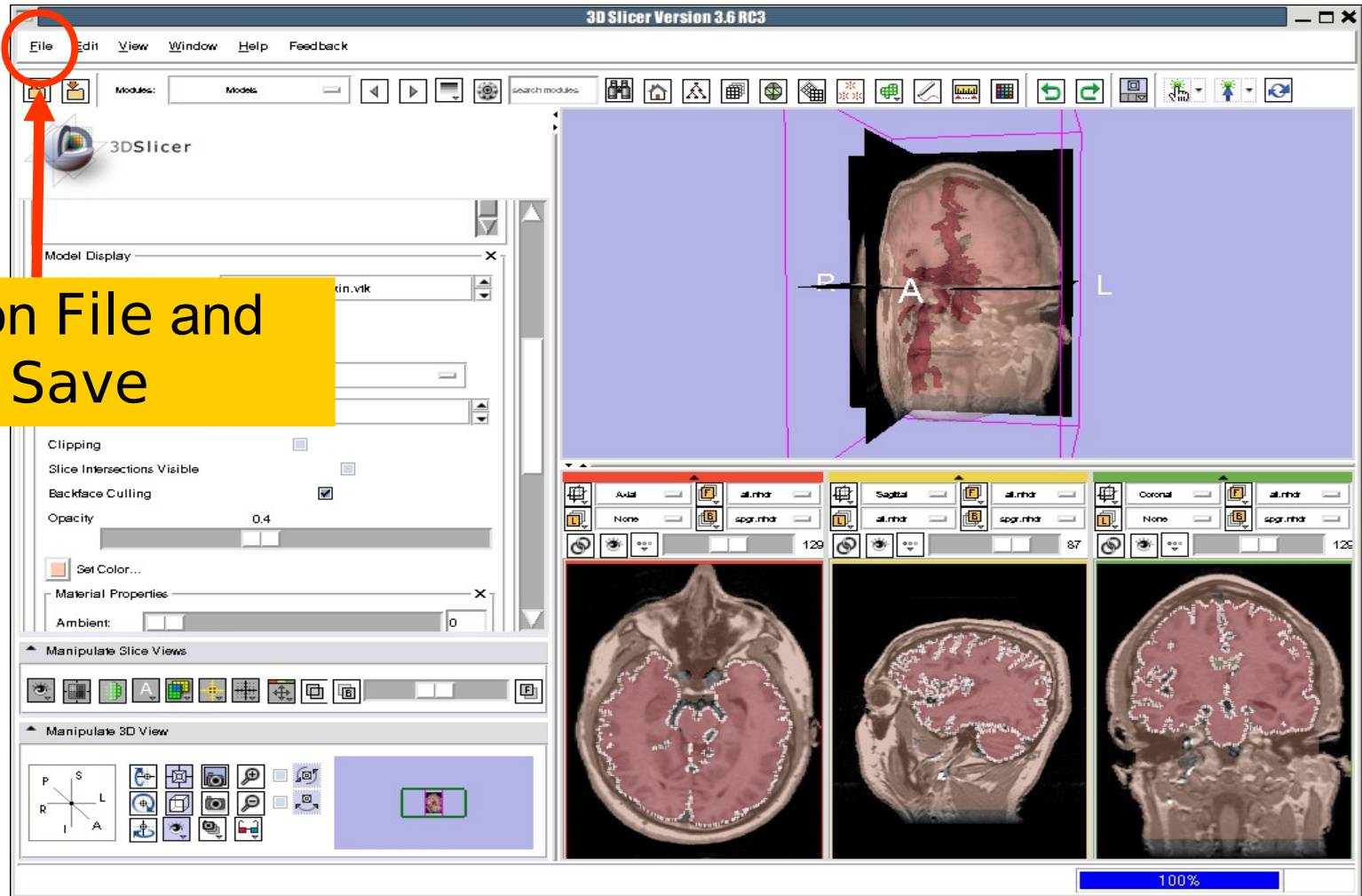




## Part 5: Loading and saving a Scene



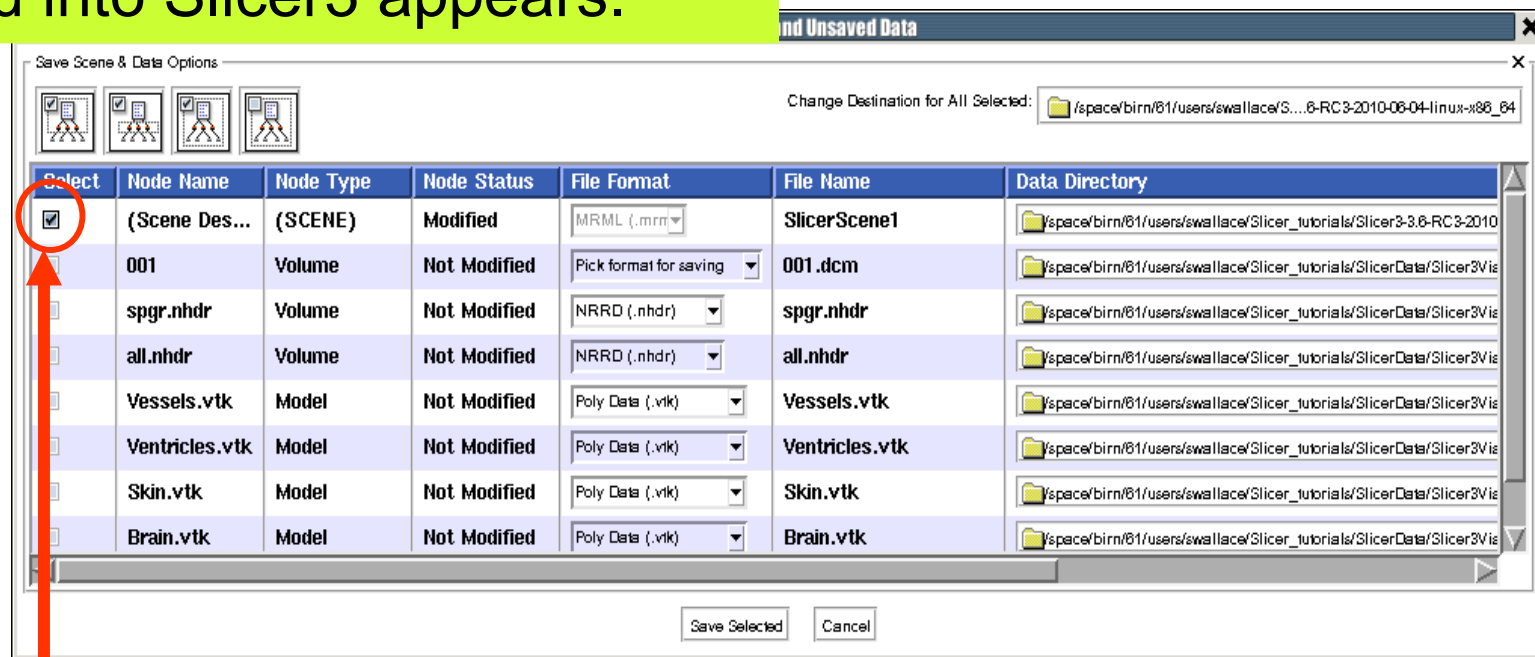
# Saving Data





# Saving Data

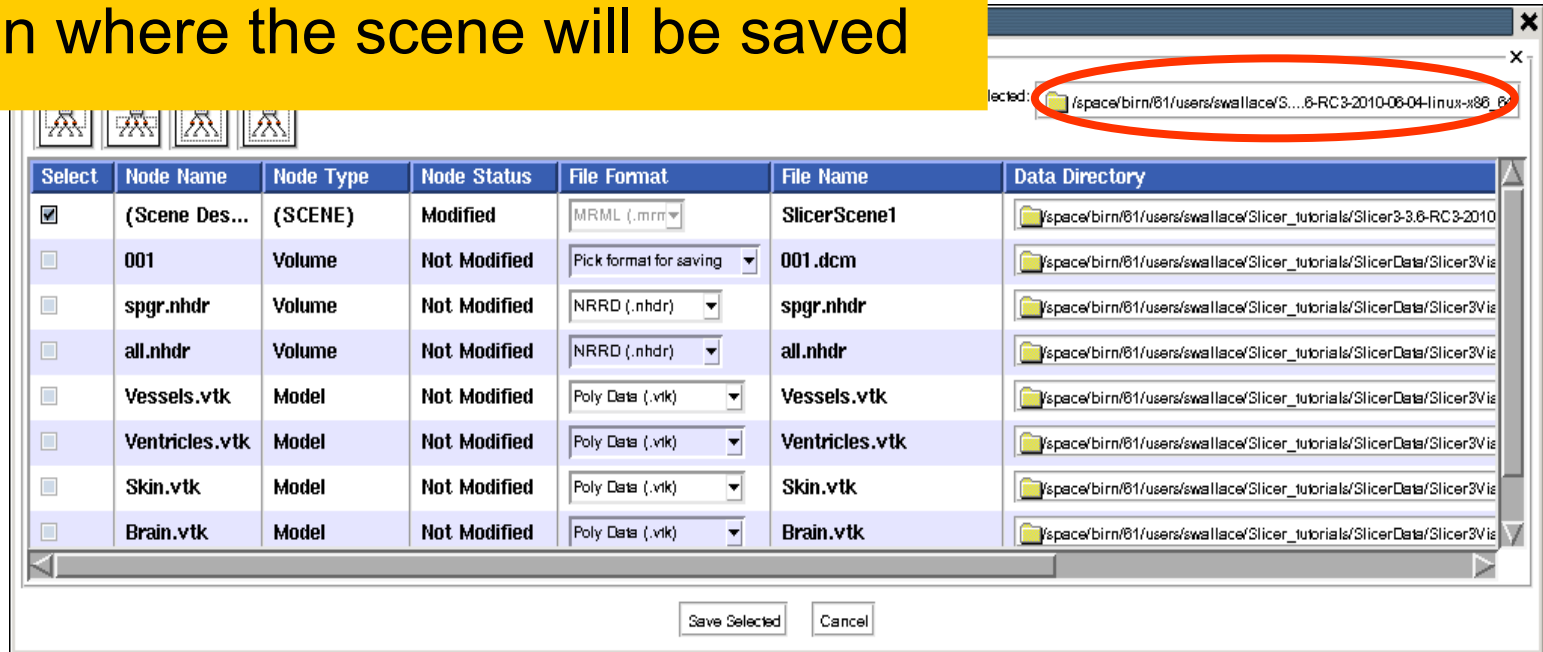
The list of elements currently loaded into Slicer3 appears.



Make sure only the first check box is selected

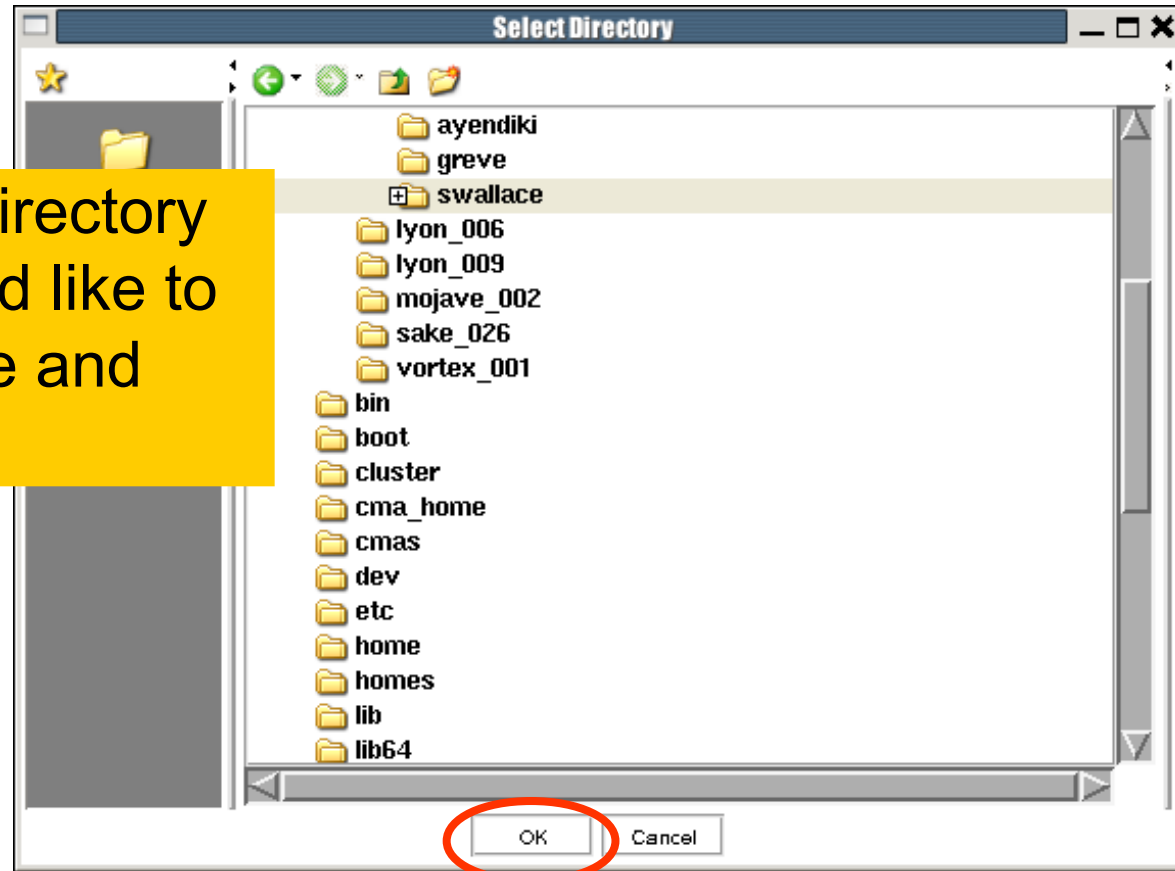
# Saving Data

Click on **Change Destination for All Selected** and browse to the location where the scene will be saved



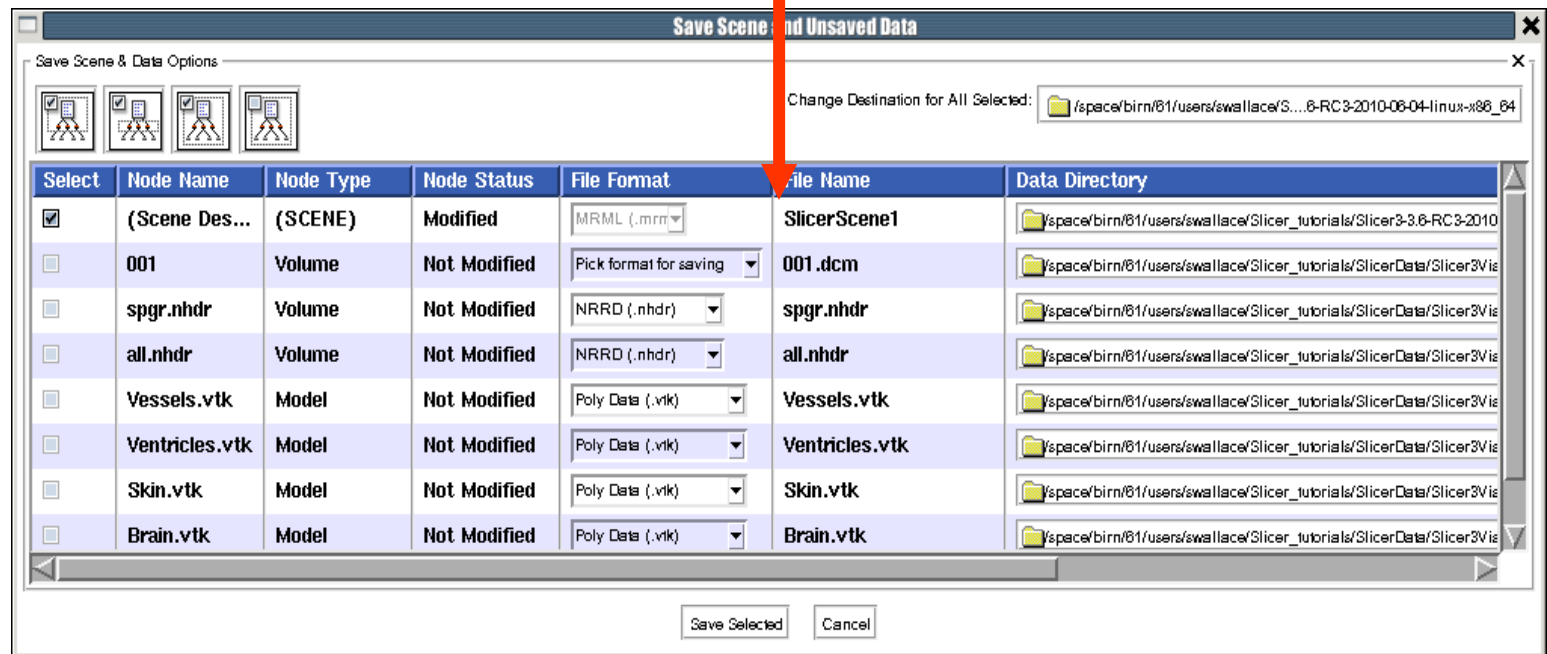
# Saving Data

Browse to the directory where you would like to save your scene and click OK



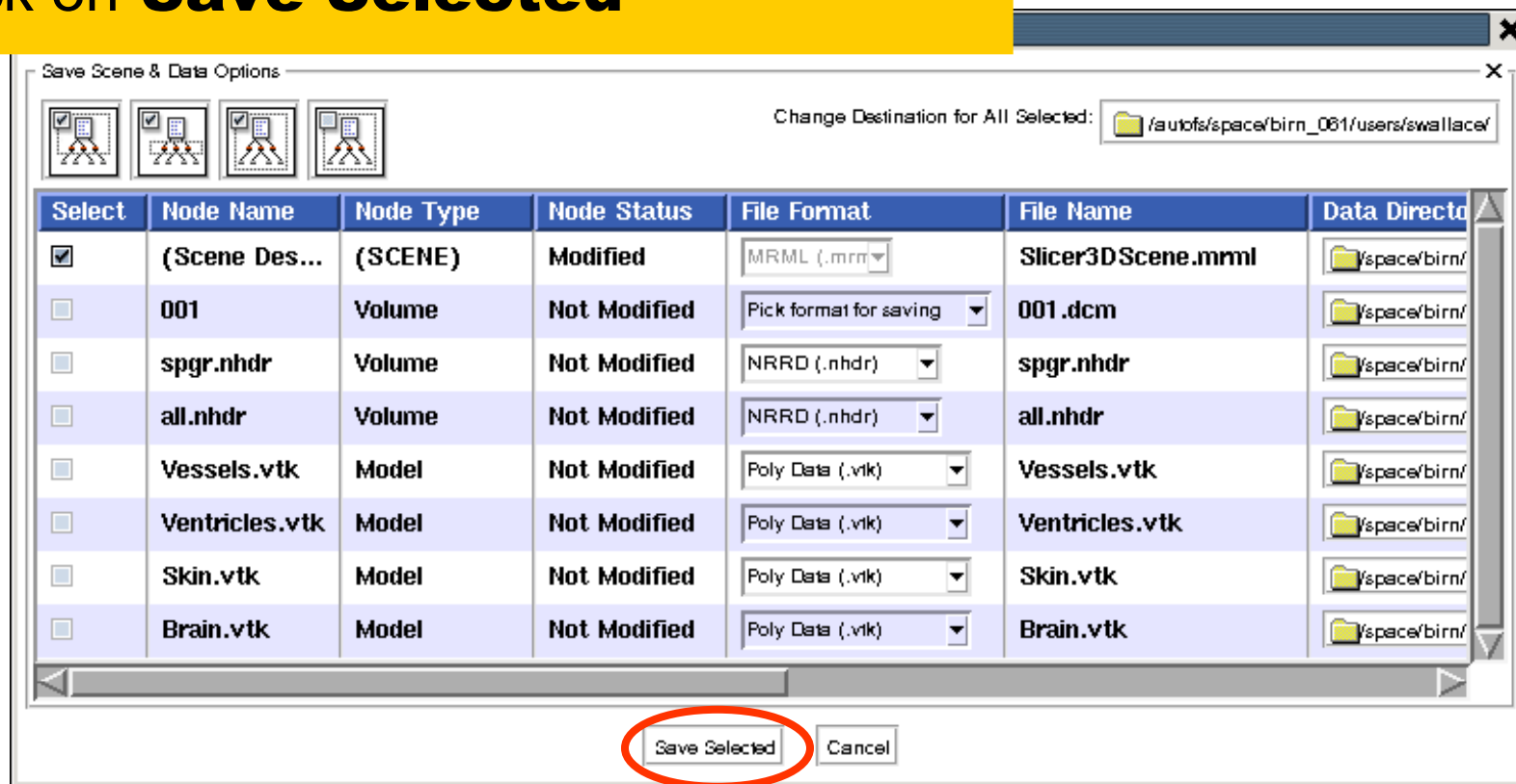
# Saving Data

Double click on the file name SlicerScene1 and change it to Slicer3DScene



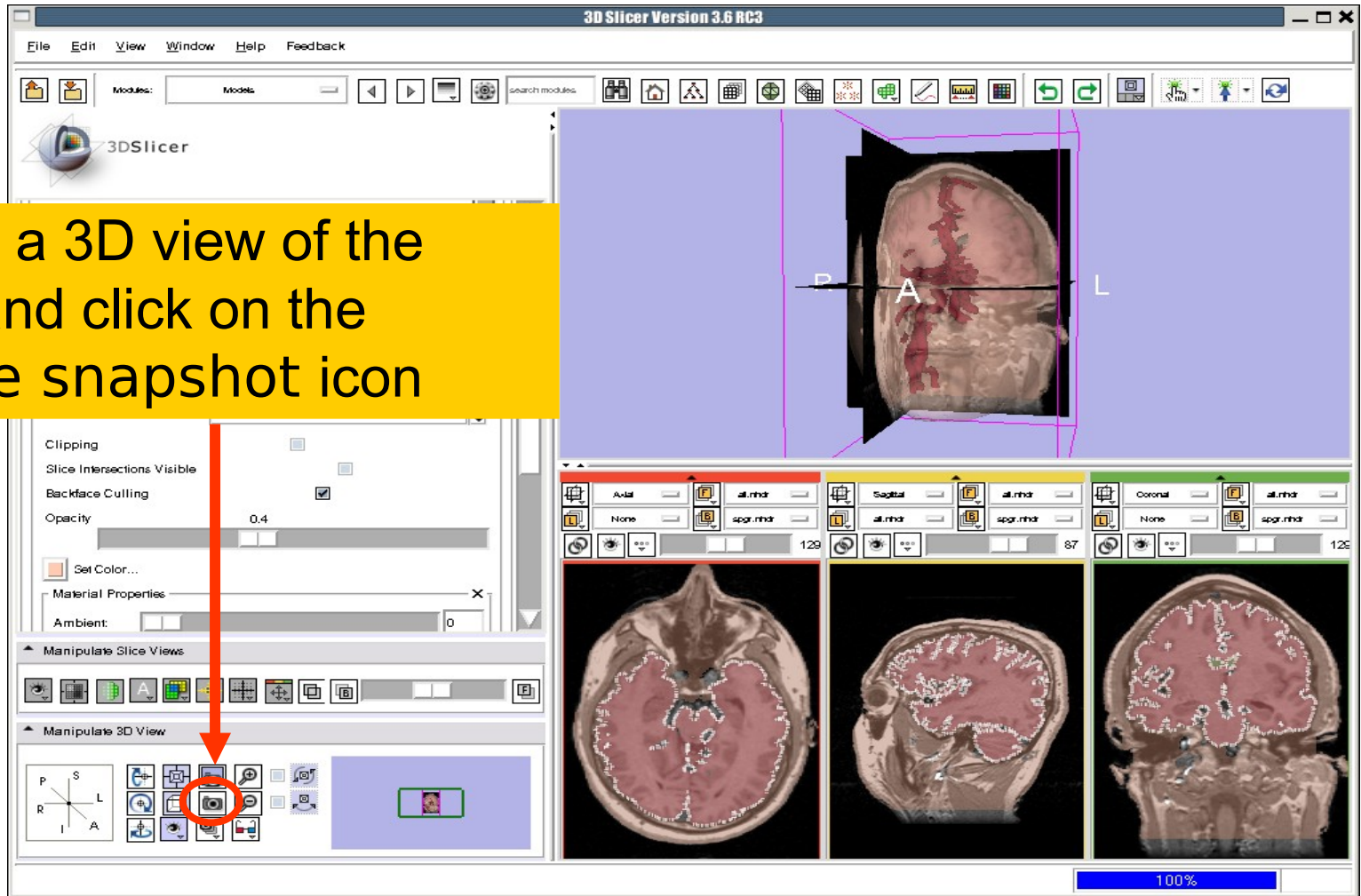
# Saving Data

Click on **Save Selected**



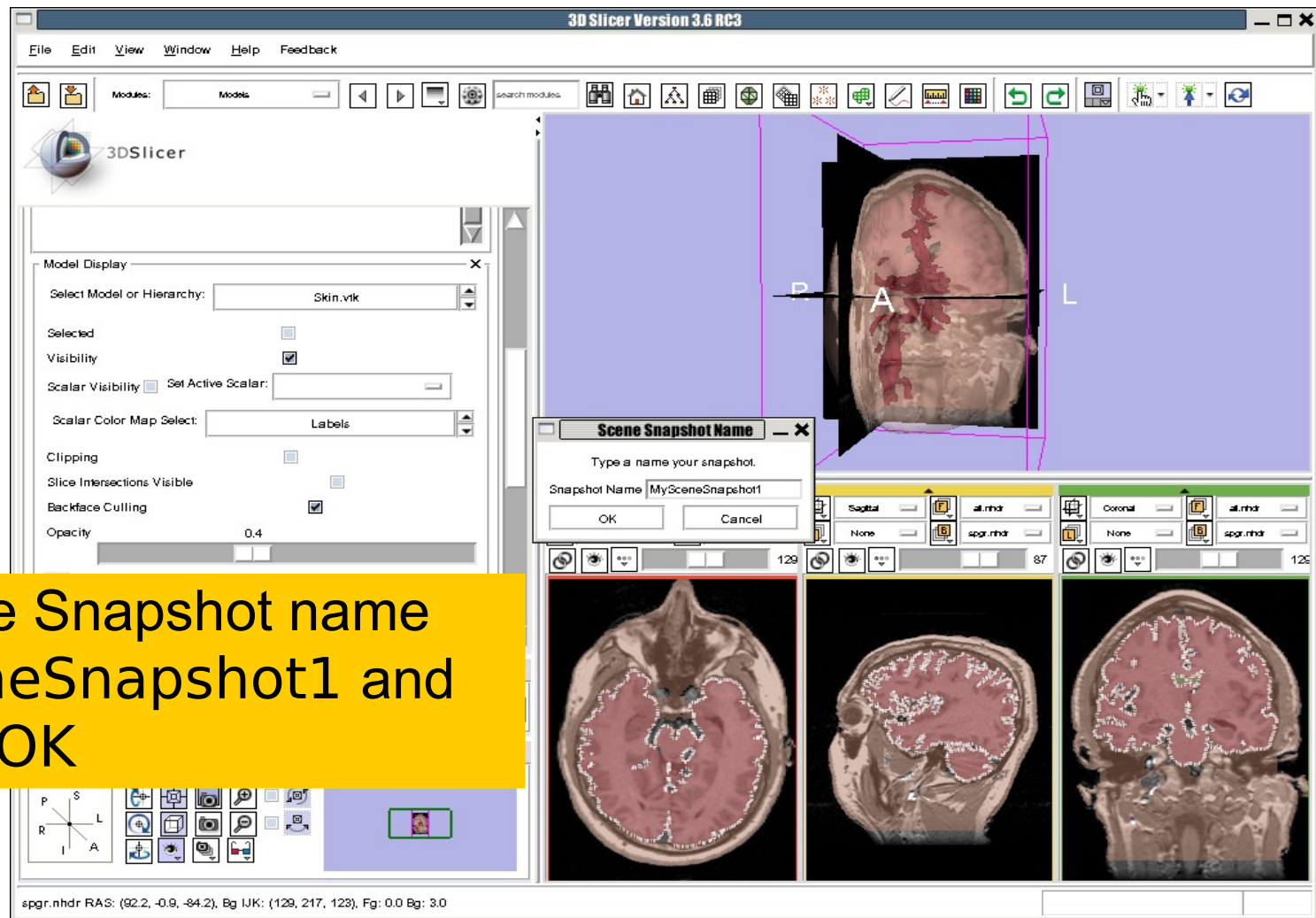
# Creating Scene Snapshots

Choose a 3D view of the scene and click on the capture snapshot icon





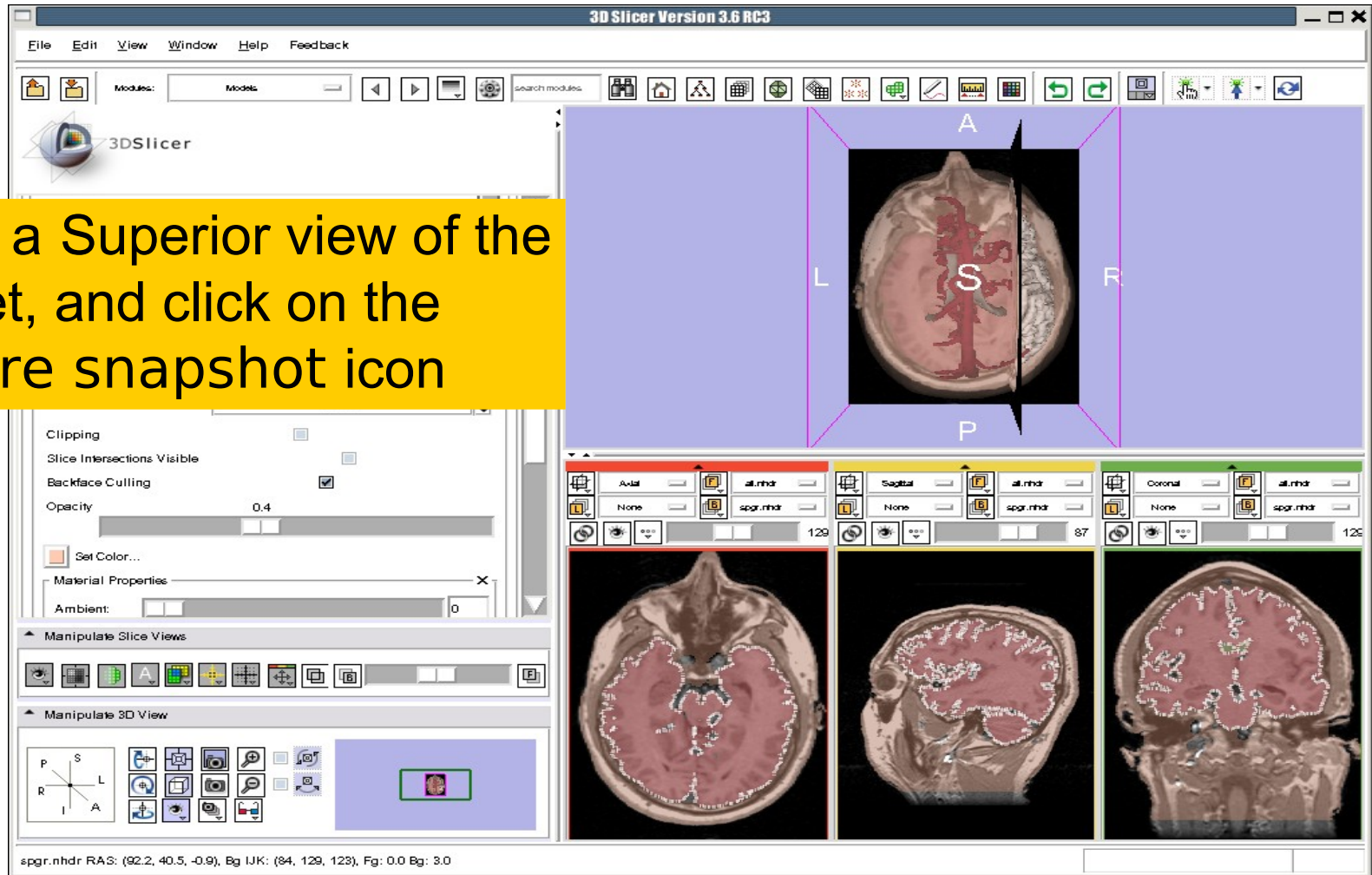
# Creating Scene Snapshots



Enter the Snapshot name  
MySceneSnapshot1 and  
click on OK

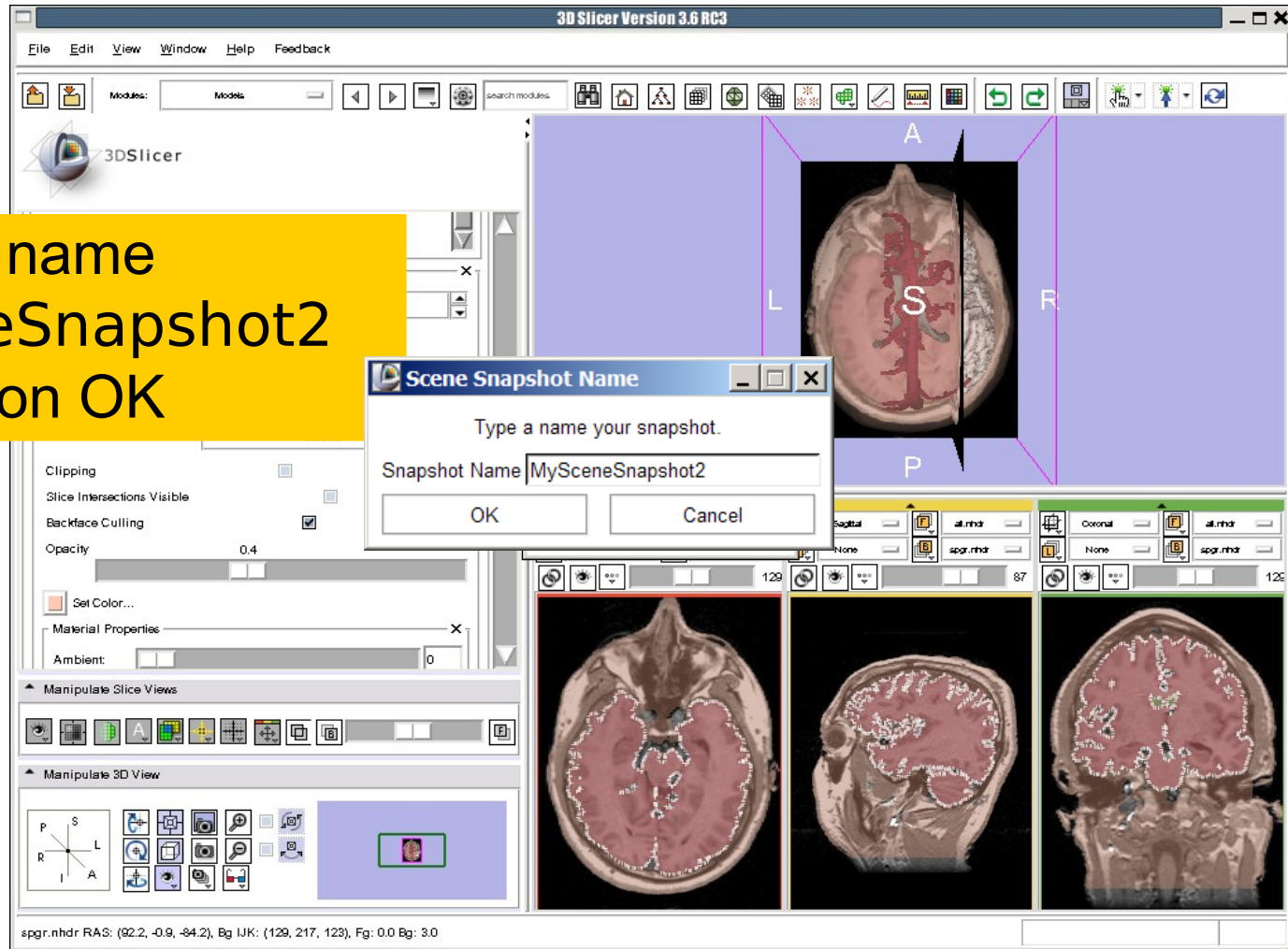
# Creating Scene Snapshots

Select a Superior view of the dataset, and click on the capture snapshot icon



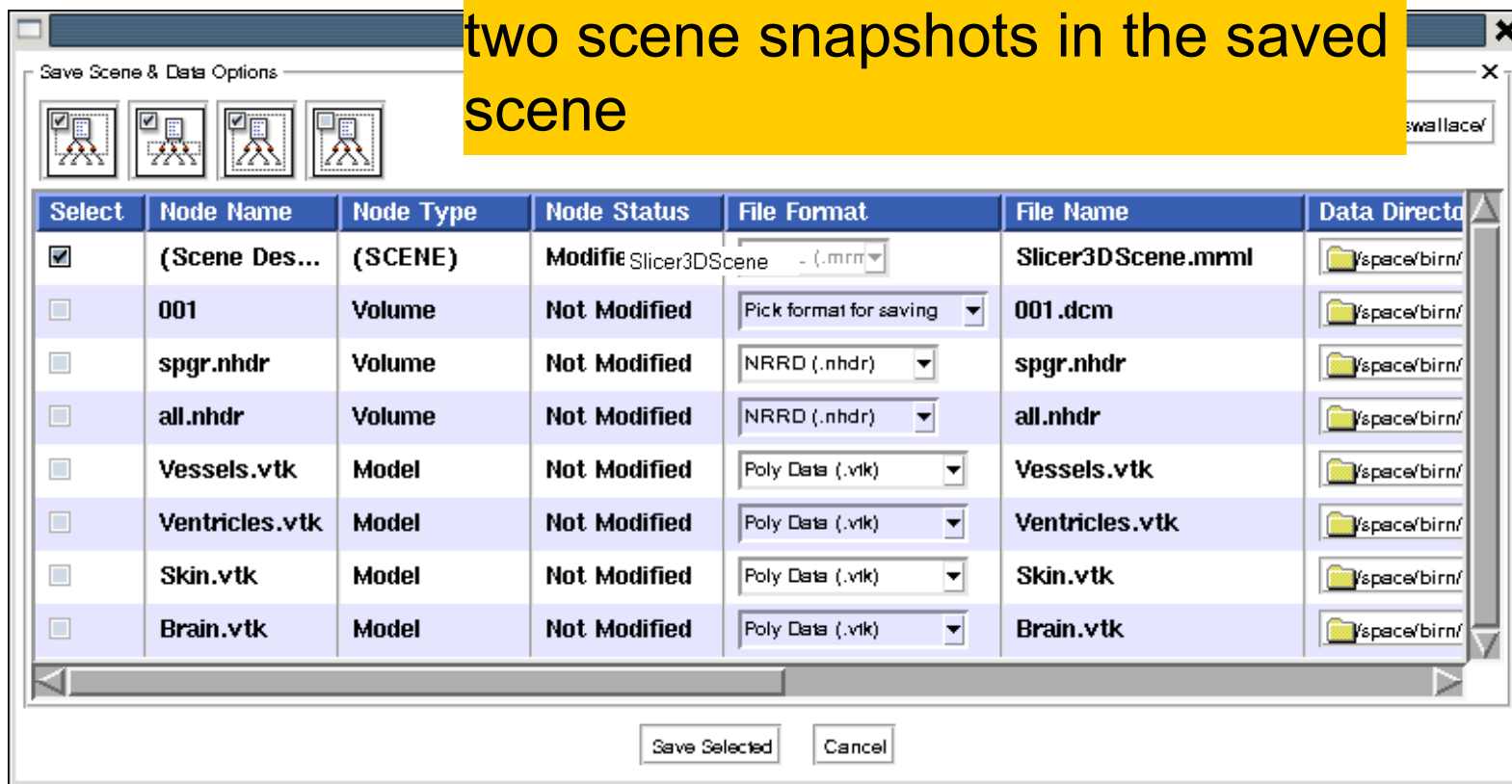
# Creating Scene Snapshots

Enter the name  
MySceneSnapshot2  
and click on OK



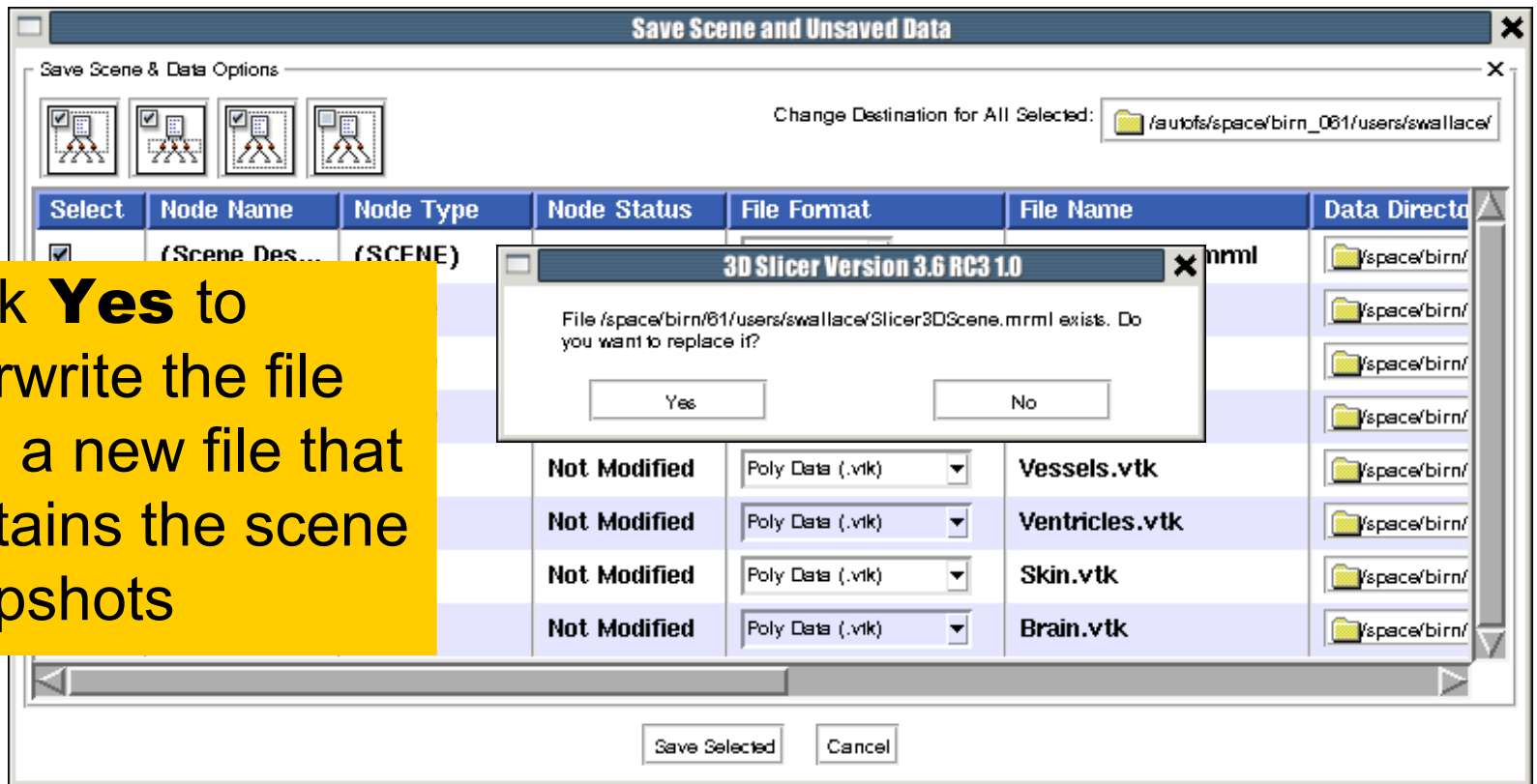
# Creating Scene Snapshots

Select File → Save and click on Save Selected to include the two scene snapshots in the saved scene



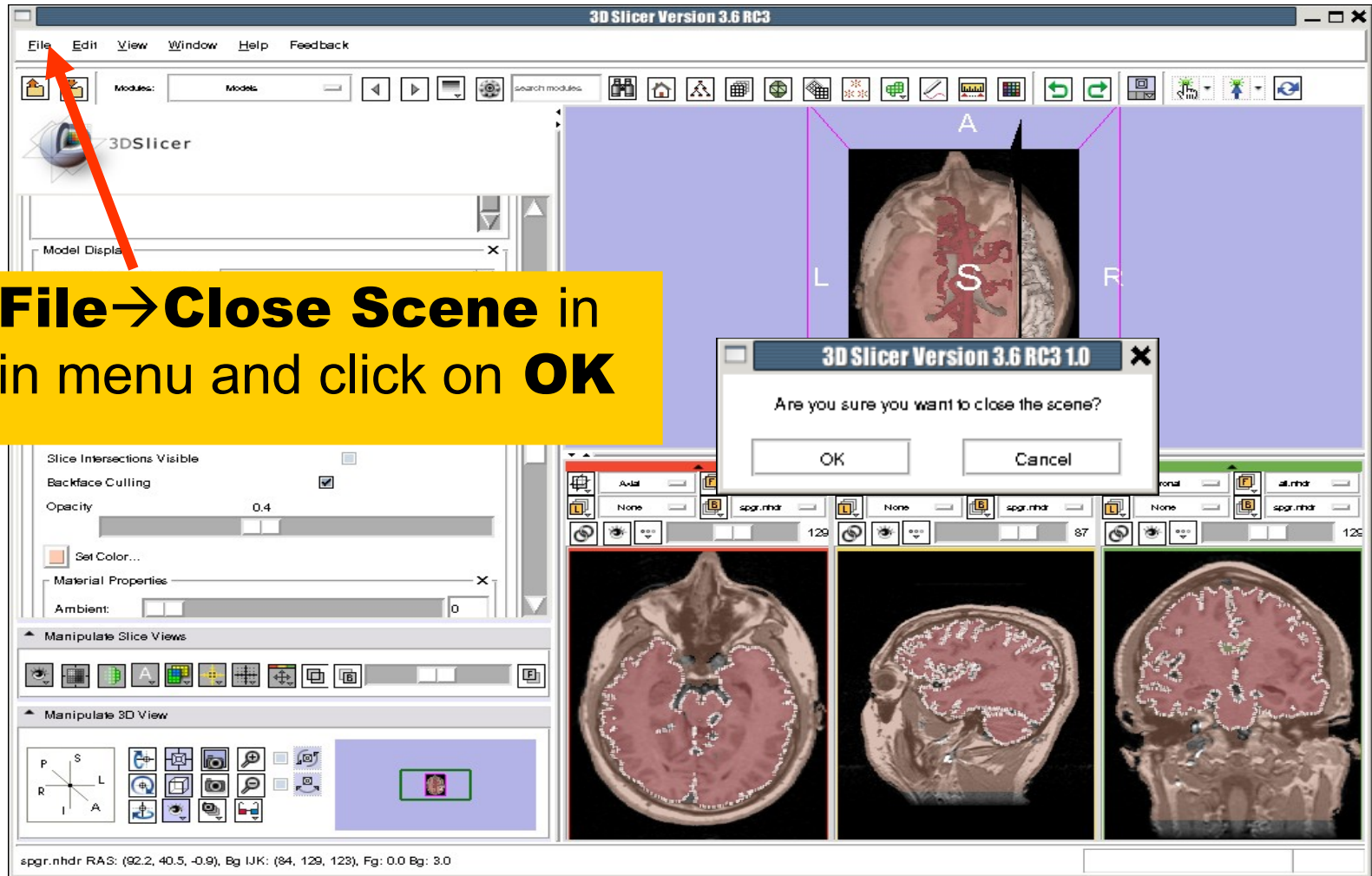
# Creating Scene Snapshots

Click **Yes** to overwrite the file with a new file that contains the scene snapshots



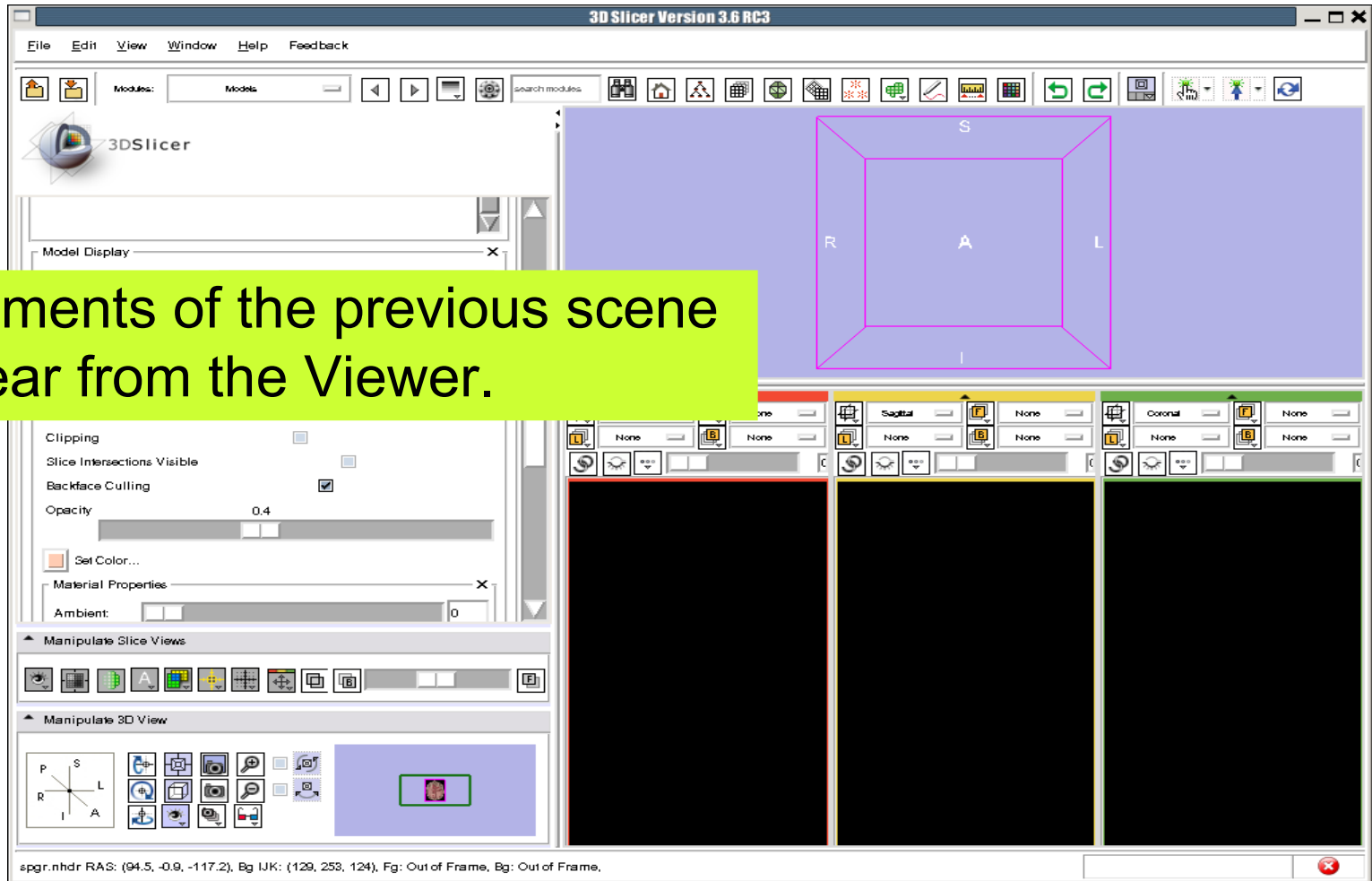


# Saving Data

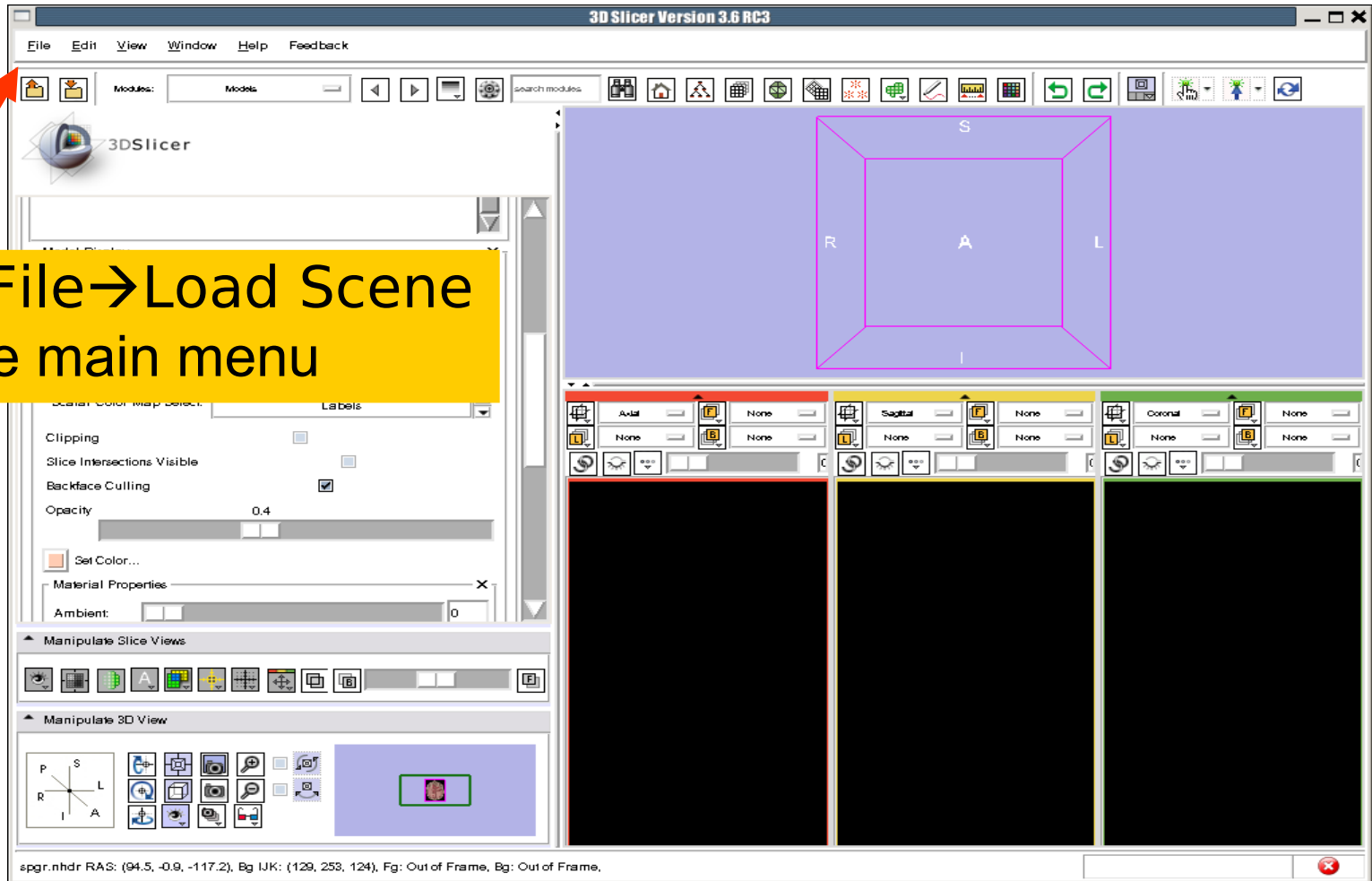




# Saving Data

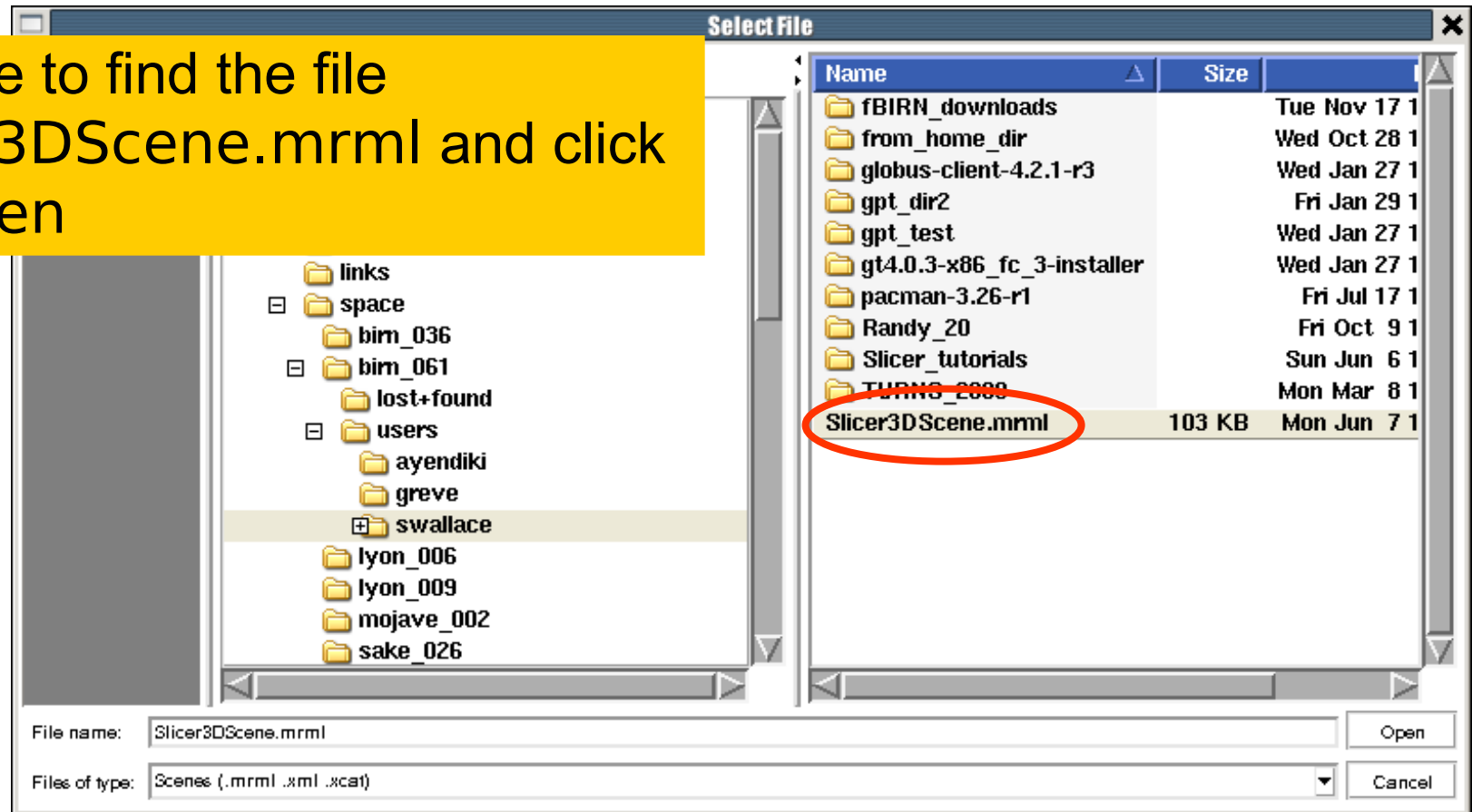


# Saving Data

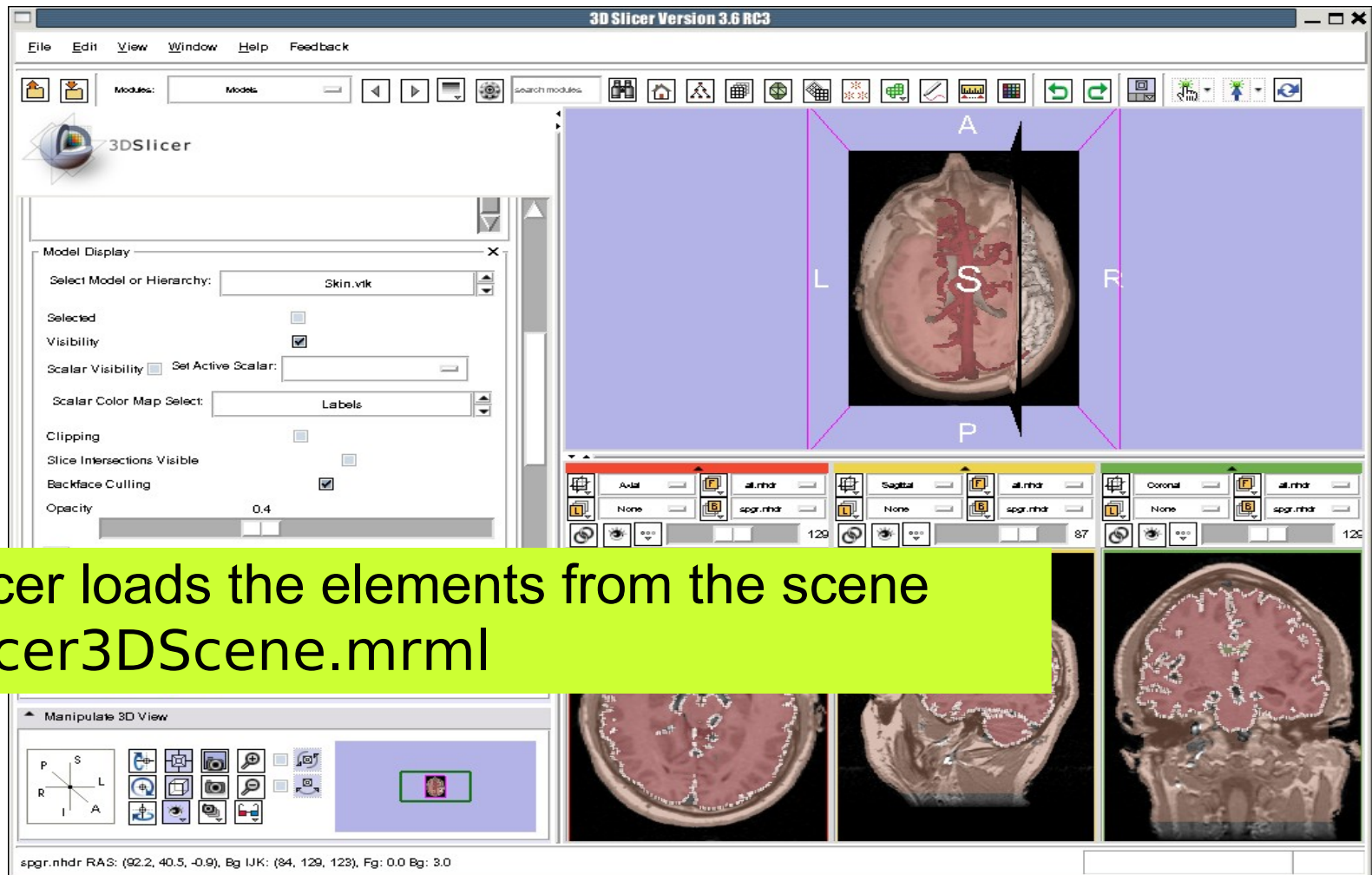


# Saving Data

Browse to find the file  
Slicer3DScene.mrml and click  
on Open



# Loading a Scene

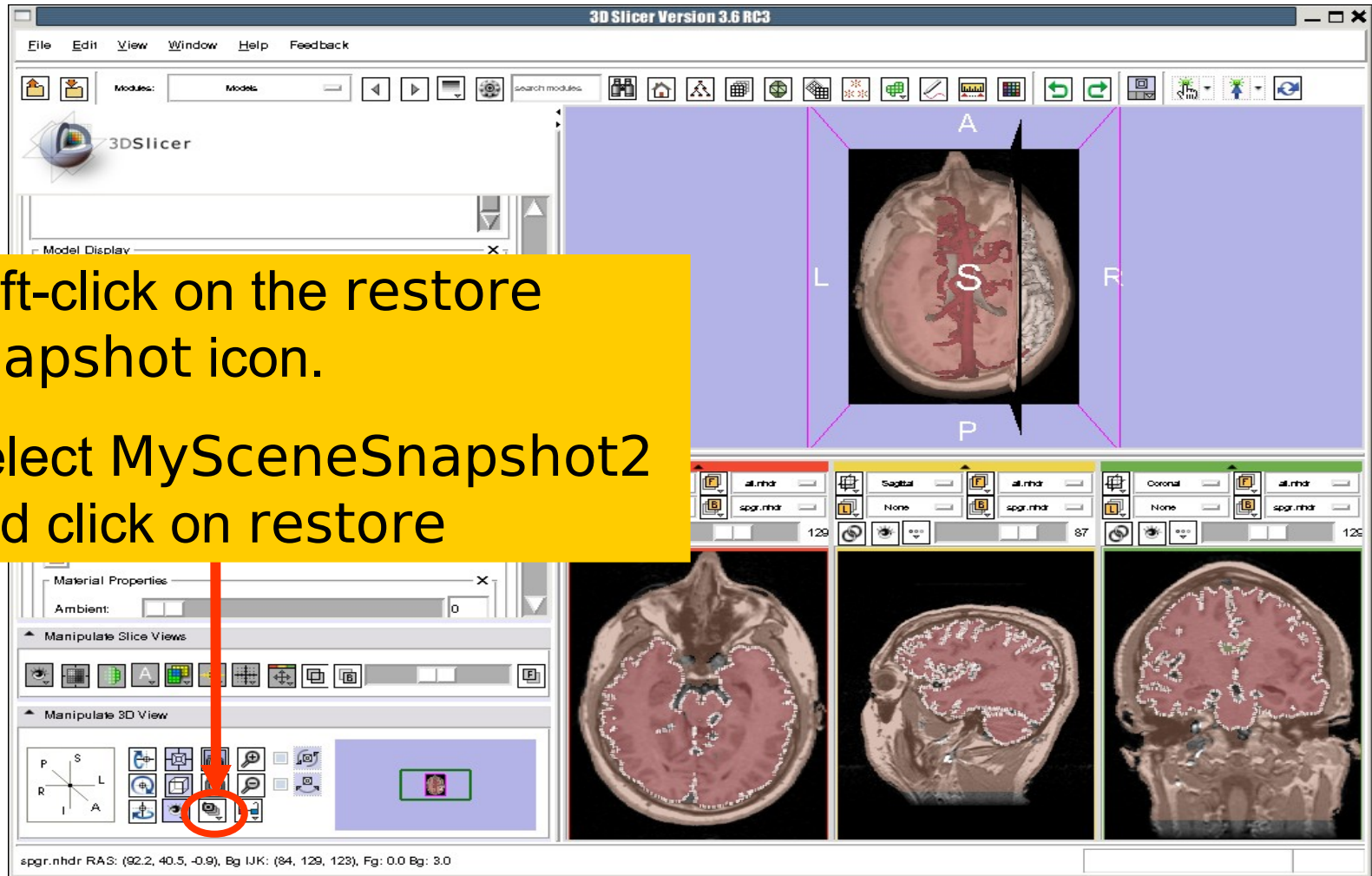


Slicer loads the elements from the scene  
Slicer3DScene.mrml

# Loading a Scene

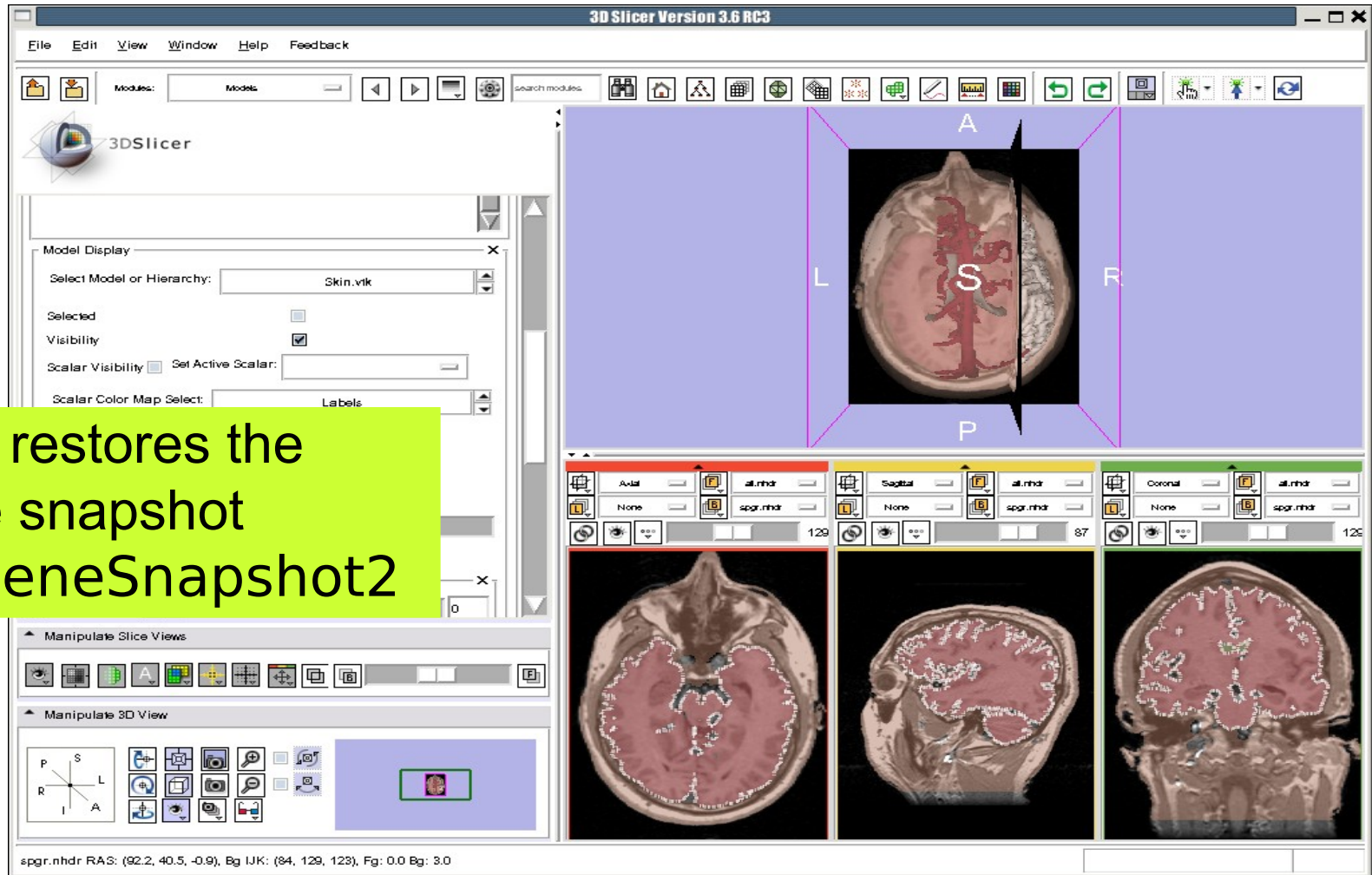
Left-click on the restore snapshot icon.

Select MySceneSnapshot2 and click on restore



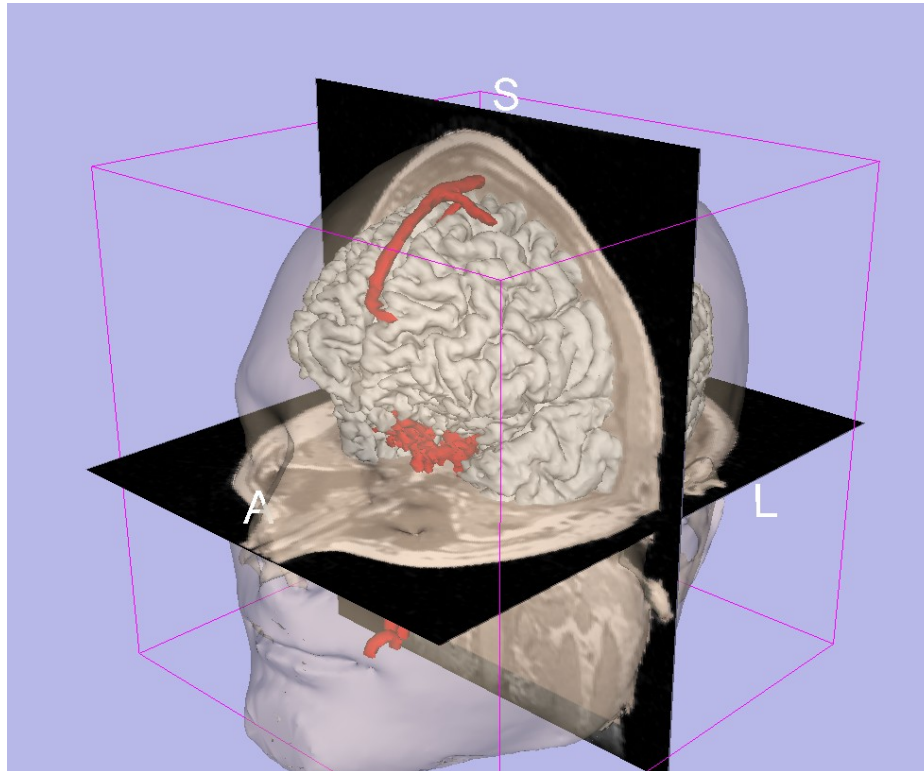
# Loading a Scene

Slicer restores the  
scene snapshot  
MySceneSnapshot2





# Conclusion



- 3D visualization of anatomical surface reconstructions
- 3D interaction with volumes and models
- Open-source platform

# Acknowledgments

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